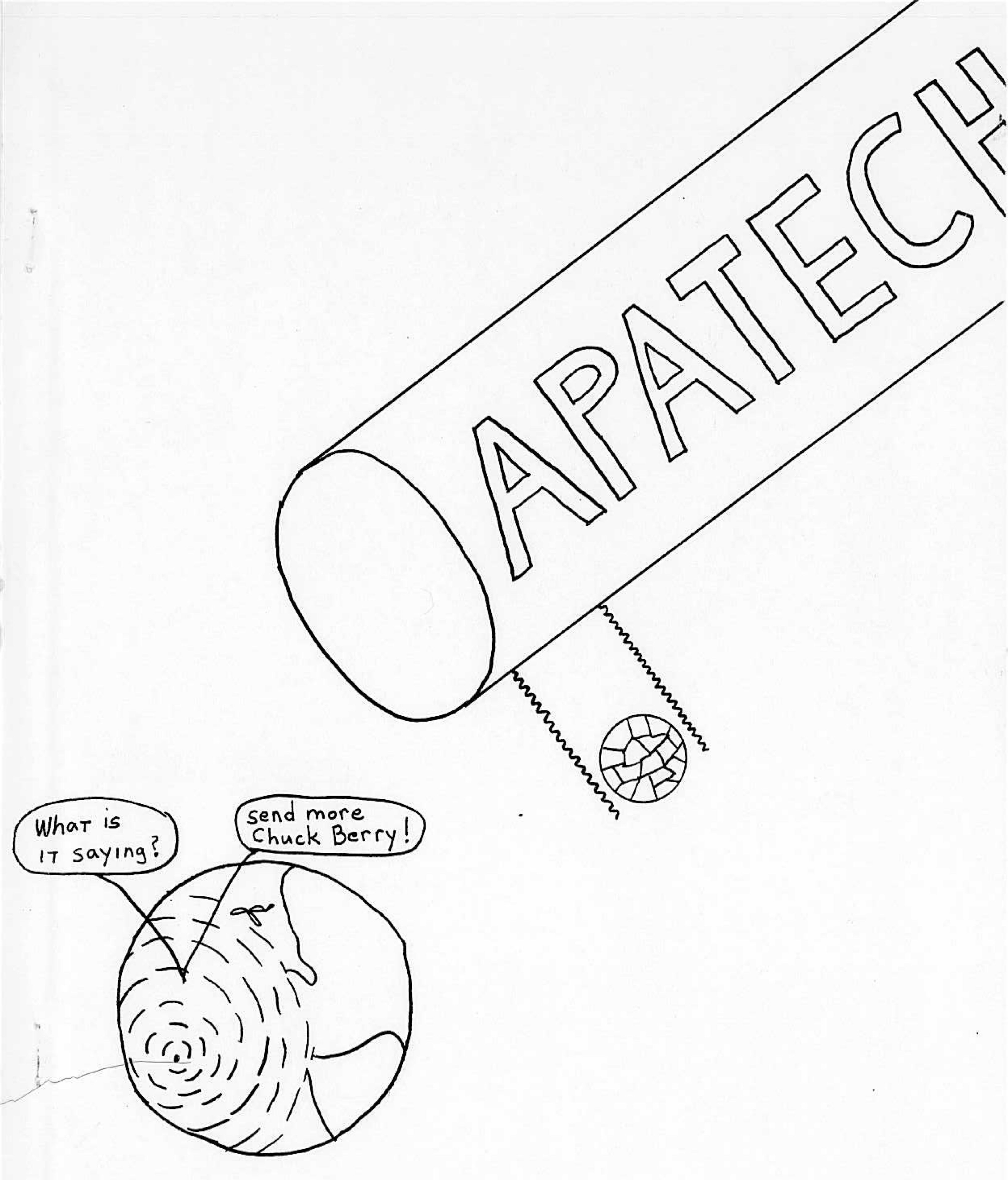
APATECH
What is it saying?
send more Chuck Berry!

BKJ

January 1987 APA-TECH 47 The 555 Times #47

The Amateur Press Association
by and for
the members of General Technics
(99 and 44/100% true)

[??]

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Decal / franked by Greg Ruffa
Back Cover / Bonnie Jones

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The copy count is 30; minimal activity is two pages every four months.

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Members added: John Hall

Members dropped: John Frambach, Eric Nash, Renee Sieber / Marty Franz

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* * *

Whoa-ho-ho!! Here I was anticipating the Massacre of 1987 and instead I had contributions just **pouring** in from all **sorts** of long-lost **APA-TECHers.** Massive burdens of guilt and threats of extinction seem to work like a charm. I see no reason to let up now, so I will insist that the minac requirement be strictly enforced. Folks seem to be acclimated now to the monthly schedule and six pages a year doesn't appear to be an unreasonable demand...

As it was, I only had to drop three parties (four people). There is, of course, still no waiting list, so anybody can hop back aboard anytime. There's a few of you whom we haven't heard from since #44, so you might think about getting something in to GTB next month. That's fair warning.

I'm not sure if GTB has already collected APA dues for this year. I believe the annual rate is $2, so if your account is really low right now (as is the case with **more** than a few of you), I would suggest getting some more cabbage in to Isher HQ PDQ.

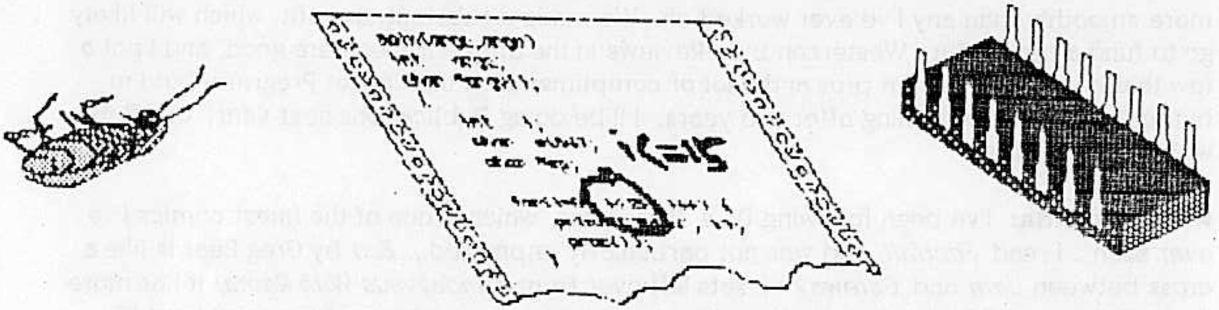
More APA covers are always welcome, too. Otherwise, the Editors may become desperate from time to time and treat you to more exploding cats' heads and strange rubber-stamp montages lampooning prominent political figures. And Who Needs That?

I'd like to welcome John Hall to **APA-TECH** in this issue and welcome back a whole buncha people with the New Year. We've got almost half the roster writing in this time and I hope we can look forward to a comparable level of activity in the issues to come!

I hope 1987 is a good year for all of you. I heard that Ishercon 9 was lots of fun (with only a few people blown to flinders); this writer hopes to put in an appearance at the tenth one. Here's handing it back to Michigan; see you in March!

Shal.

Dead Bugs



A zine for APA-TECH from

David D. Levine
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`...tektronix!ogcvax!inteloa!davidl` (or something like that)

Dead Bugs. Why, you may ask, do I choose to call an APA-zine "**Dead Bugs**"? Many reasons:

- We recently repelled an invasion of six-legged visitors from our kitchen. The uninvited guests were given a grand send-off with chemical warfare. **Dead Bugs.**
- I have been doing quite a bit of work with a developing and under-maintained software system. Every once in a while I find a problem and fix it. **Dead Bugs.**
- A cubicle in the building where I work was, until recently, filled with miscellaneous unused hardware and software cast-offs. When I inquired as to its origin and disposition, I was told that it was all that remained of the old 432 development lab. **Dead Bugs.**

[This last point may require a bit of explanation. As some of you know all too well, the 432 was Intel's hot new microprocessor a few years ago. Object-oriented, capability-based, features up the ying-yang... lots of people loved it. Slow, complicated, and virtually impossible to program... lots *more* people hated it, or were at best indifferent about it. The 432 product went nowhere, and was quietly cancelled, so it's a dead "bug", or chip. With any luck, they've learned from their mistakes.]

[Oh, and before you ask... no, I didn't get any scrounge from the old 432 lab. The next time I came by, the last of it had been shoveled away to parts unknown.]

Speaking of which, work continues apace. In the last five weeks I've delivered no fewer than three manuals for review: one (500+ pages) I wrote entirely from scratch, one (125 pages) I edited extensively from something written by another Intel writer, and the other one was lightly-rehashed industry-standard documentation. I'm pooped, but there's no end in sight. Today is December 23. Tomorrow I'm going to Eastern Washington to spend the holidays with Kate's folks (her father works for Westinghouse at the Hanford Nuclear Reservation). The following Monday I'll be back at work: I have a December 31 deadline for a second lightly-rehashed manual (light rehashing is easy; I'll make it, no sweat). First project for 1987: revise my schedule to accomodate another manual I've been assigned to write. Aargh!

On the fan scene since last I wrote: There was Worldcon, where I saw many of you, and which I enjoyed tremendously. There was OryCon, where I was Programming Director: a position that included Pro Liason, Panel Scheduling, Pocket Program, and Daily Zine, not to mention being one-fourth of the Executive Committee. (At least the way I do it.) Ed Bryant was GoH, George R. R. Martin was Toastmaster, Jessica Salmonson was Editor GoH. (What, no Fan GoH? Well, we picked the guests first and assigned the positions later...) The con went more smoothly than any I've ever worked on. We made a substantial profit, which will likely go to fund a near-future Westercon bid. Reviews in the area fanzines were good, and I got a few thank-you letters from pros and a lot of compliments on the Pocket Program, but I'm burned out on programming after two years. I'll be doing Publications next year. Our GoH will be Tim Powers.

Recent reads: I've been following DC's *Watchmen,* which is one of the finest comics I've ever seen... I read *Footfall,* and was not particularly impressed... *Eon* by Greg Bear is like a cross between *Jem* and *Gateway* on sets left over from *Rendezvous With Rama;* it has more "scope" than any SF book I've read in a long time, and manages to combine good hard SF, political intrigue, and strong characters in a fairly tight package. One quibble: Bear can't write descriptions to save his life. I had to re-read some passages three times before I figured out what the thing being described was supposed to look like. He has an annoying habit of having something described the same way from two or three different viewpoints, which doesn't help. On a more technical front, I've read and can recommend *C: A Reference Manual* by the folks from Tartan Labs, which is like Kernighan & Ritchie brought up to date. It's readable, it's comprehensive, and it contains a lot of pointers on writing portable, bug-free code. ($22 in softcover: ouch).

Recent views: *Star Trek IV* was fun, but it was heavy on the cheap laughs and *real* light on the plot and character development, never mind the technical and scientific blunders (spacecraft deprived of power coasting slowly to a stop? A *hatch* on the bridge of a warship?). In terms of developing any kind of dramatic tension, it was poorly crafted; I didn't *care* whether or not they survived Crisis #53. I give it three stars, tops. I hope that they've gotten it out of their systems and that they get back to something with as much meat as *Wrath of Khan* for the next one, but the massive critical and audience success of this one makes that highly unlikely. // *Little Shop of Horrors* was even more mindless, but I enjoyed it whole-heartedly because I didn't *expect* plot or character development. It's a big-budget musical comedy, somewhat reminiscent of *Rocky Horror* only better. Wonderful songs, very Fifties and early Sixties in feel. Many fine performances, good cinematography, really great sets, and the best performance by a plant since the original *The Thing*. See it. // *Futuropolis* is a short film (longer than a short subject, but far shorter than a feature) combining pixilation, cel animation, drawn animation, clay animation, drawing right on the film, and several other varieties of animation and live action into a wild romp that pays homage to Flash Gordon and Max Fleischer. Camp, fun, weird. They even have someone shoveling pitchblende into the radium furnace. Neat stuff, but you'll probably never get a chance to see it. Do so if you can. Kate and I did *Futuropolis* costumes for OryCon; everyone thought we were the Jetsons.

Other stuff: Megamax finally came through with the upgrade to their Macintosh C compiler, so it works with my system again. // I got an invitation to Ishercon, which I would love to attend but can't make this year, and seriously considered sending an entry to the Bomb Contest in the mail, but stopped when I realized what would happen if some Postal Service employee got suspicious about the package (the rules say it *has* to look real) // I'm looking for a laptop/notebook computer, mostly for writing (APAs and such). Any recommendations? It must be able to communicate with the Mac in some way (straight ASCII via serial port is fine). PC compatibility is not required but would be a plus. I don't want to spend more than $300-500. The TRS-80 Model 102 would be acceptable if the screen tilted to...

a comfortable angle and had a few more characters on it. The Epson Geneva is very close to what I want, but it's too expensive and I think Epson's stopped making it. DAK is selling Genevas well below list, but they refuse to sell it without the printer and I really don't need another one.

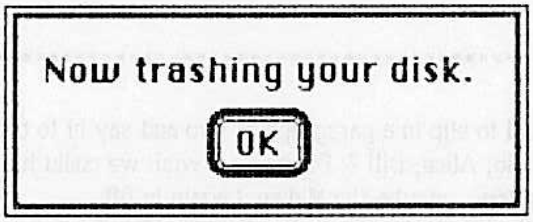
Oh, I can blather about myself all day, but I'm sure you've got better things to do than sit here and listen to me. On to the Mailing Comments.

Mailing Comments on APA-Tech #46:

Cover: Nobody has ever succeeded in explaining to me *why* Tullio, who hates everything, likes Exploding Cat Heads (with water, of course). // How long has this piece been hanging in the kitchen at Isher? You folks must be *desperate* for covers. I'll see if I can send something along next time.

Sheila: It's true that most people overlook North Dakota, but many people (even U.S. Government officials) think that New Mexico is a separate country. One New Mexico paper has a regular column of incidents of this sort, and they just published a book of them. // "A married male 23 year old co-worker confessed that he didn't know how The Pill worked" -- I thought *nobody* knows for sure how The Pill works? (But people use it anyway because it's been proved acceptably safe and effective through experiments. The Scientific Method in action!) // My parents joined Book of the Month to get the Compact Edition of the Oxford English Dictionary... 4000 pages of *words words words!!!*... Kate and I just got one last month, but not through Book of the Month; we bought it used at Powell's (the West Coast's largest used book store, which is a mere nine blocks away from our place).

Guy Wicker: Many Mac operations can be aborted with Command-Period, but not all abort cleanly. I've grown to hate dialog boxes like this one:



Now trashing your disk.

(Joke.) Still, I prefer the Mac to the IBM PC for ease of use and consistency. Also, keep in mind that the Mac's forte is to generate good-looking paper output as quickly and easily as possible. If your task is one where the end product is paper, and appearance counts, the Mac is wonderful. If not, the Mac might not be the best machine for the job. (I think the Mac is *great* for APAs, and I know lots of people who agree.)

On the other hand, the Mac still hasn't got any software for big projects like the one I'm working on at Intel. It would have to support 15-20 people working on pieces of the same document, documents with independent but interrelated structure and appearance, automatic numbering and renumbering of headings, powerful automatic indexing and Table of Contents generation, ability to build documents from smaller parts flexibly, revision control, etc. But it was never meant to be that kind of machine. Now, if you're downgrading the Mac because it doesn't have multiple floppy drives and a hard disk, you're just not being fair. These peripherals are readily available from a variety of sources; you should compare comparable systems. (Did you honestly expect to be able to do useful work on a machine with one floppy disk drive and no other storage?)

Okonomiyaki is Japanese Pizza? Well, I'll admit I've seen packaged okonomiyaki mix with the translation "Japanese Pizza" on the sticker on the outside of the box, but I've made it a few times from scratch (recipes from the newspaper) and it's nothing even remotely similar. More like Japanese Quiche, or maybe Egg Foo Yung. Now, if I ever had it in a restaurant, I might find that the way I make it is way off base...

Guy Consolmagno: I am mailing you, under separate cover, an article from *Washington University Magazine* (too long to reproduce here) about the future of space research after the Challenger disaster. Hope it helps.

Rod: Haven't seen any of the animated shows you mention, but local author Steve Perry is making a steady living writing for animation, and he's got some saaad stories. Example: another author *knew* that the producers would have spaceships making noise as they landed on the moon, so he added a line to the effect that "the ships' engines generate radio interference in the helmet 'phones" to explain it. When the show actually got on the air, they'd changed it to "Boy, that spaceship sure is loud!!" "Yeah, and if we didn't have these helmets on, it'd be even louder!". // Britain is a managed *ecology?* Did you mean *economy*, or do you know something I don't? // Re yr cmt to Barry: Worlds of Wonder, Inc., has sued a company that was producing lower-cost Teddy Ruxpin cassettes, claiming that the cassette format is proprietary; they seem to have a strong case. Somebody better tell Todd to keep what he knows under wraps, or they may sue him too...

It's getting quite late. Time to get to bed. Tomorrow I must pack for the trip to Kate's folks' place, so it's RAEBNC to everybody else.

See you in the funny papers,

- David

****

Hello there. I told David I wanted to slip in a paragraph or two and say hi to those of you that I met at Windycon last year– Donna, Tullio, Alice, Bill & Barry.... I wish we could have gone again. Next year we're planning to go to Brighton... maybe the Midwest again in 88.

Those of you who don't know me– I know you-u! I read David's APA-Tech con mucho gusto, every month. (Especially enjoy Crumbcrunchers.) No, I don't want in, I've already invaded his other APA. Besides, I'm not a Techie, and I think that common thread running through most of the APA is a strength, even if I can't understand half the discussions. The bomb contest at Ishercon sounds like, well, a blast. I just want to speak up sometimes.

About Madeleine L'Engle: she is unquestionably my one favorite author, for body of work as a whole. I got to talk to her for about an hour once -- she was GoH at a small, small Darkover con in Oakland. It was worth the trip. Marvelous lady. I disagree with whoever said her juvies don't hold up for adults; I was always pleasantly surprised that the protagonists I related to when I was 11 still seemed like contemporaries when I was 19. Odd too how her books so often deal with Death, Hate, and the threatened Ultimate Triumph of Evil in the Universe, and yet come out so *comforting*.

I remember the burst of delight when a friend pointed out that the mother seen briefly at the beginning of Dragons in the Waters is *Meg*.... married to whosis the sport.... Madeleine so loves to intertwine her characters from one book or family-line to another. Severed Wasp is sort of an extreme example, tying together threads from all over as it finishes the story of the protagonist from her very first novel. Well, the latest one in the Wrinkle in Time sequence, Many Waters (?) has geneologies in the endpapers. Hurrah. I've got crumpled 3x5 cards in every book, from trying to sort things out.

Out of room. Must run. Happy Irving to all and to all a good night.

Kate Yule

An Unsuppressed Transient, January 1987

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Hi. Remember me? By all accounts, I should have gotten back in touch ages ago. I don't have the time now to fill you in on all the gory details of what I've been up to since I last wrote, but I'll instead attempt a brief synopsis.

If you'll remember, I was living in New Mexico for a while, working at Los Alamos. All good things eventually come to an end, as did my appointment there. I left myself a week to move myself from there back to Chicago before taking the GRE advanced test in computer science. I didn't count on my car's cooling system dying in three installments in three small towns along Route 66 in Texas and Oklahoma--first the water pump belt, then the water pump, followed soon thereafter by the radiator. My old Fiesta and a rooftop carrier were filled to the gills with my heaviest possessions, as the lighter ones had been shipped. Getting parts on short order for the Fiesta in that part of the world is at best entertaining, and at worst . . . well, never mind. I was fortunate to have my bicycle with so I could get around sans car. The only problem was that all transportation by the natives in that part of the world is via pickup truck, not such antiquarian modes of locomotion as walking or riding a bike. This explains why the local canines found my bicycle riding so fascinating. One charming beast broke free from its fetters and gave chase. From the corner of my eye, I saw this huge black mass with red glowing eyes closing in, its claws clicking on the pavement, and its growl distorted by exertion. With luck, I went anerobic longer than it did, and thus was able to continue my odyssey intact. Because of time and space constraints, I'll spare you all of my other wonderful anecdotes of that trip.

I finally got home to Chicago with one day to review before the exam. You may have seen me the evening after the exam on Saturday looking a little wasted; it was the weekend of Windycon last year. I was out of work (and not excited about it) from then until the new year. January 2 of 1986 I started a job at the Argonne National Laboratory which lasted until the end of August. It was a wonderful job. I learned the arcane invocations which mortals call UNIX. And I got to program all sorts of new advanced architecture computers--shared memory parallel processors, hypercubes, vector pipelined supercomputers, and vector pipelined shared memory multiprocesssors. I was once again unemployed this September. Fermilab interviewed me during a hiring freeze for an inappropriate job, which is par for the course from what I've heard of that place. I ended up accepting a position, in the middle of October, as a research programmer doing FORTRAN under UNIX for an options trading partnership located in the Board of Trade building. The people I work for now are very progressive with respect to how they treat their employees. There's no dress code, no set time to be in to work, and they feed me free breakfasts and lunches (a policy which gets more work out of the workers in a given day since there's no reason to leave the office).

These folks who hired me also have some of the best hardware and software. All of the research people are given their own Sun-3s to work with networked to some really nice machine I worked with at Argonne (which I can't tell you about). So much for making a living, and on to the real dirt. I'm engaged!

Annette Kavanaugh is the other party. The date is set for the Ides of March minus one. Most of you have met Annette already at various cons, but for those who haven't, you'll have to wait until my next submission (which you should not have to wait long for this time).

I only have time for one outstanding mailing comment: Rod, my experience has been that ambidexterity results in problems discerning left from right for a lot of folks. Choosing left or right for these people is generally an intellectual process and never becomes fully automatic.

Hope to see you all soon wherever.

CRUMBCRUNCHERS, INC.

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A submission to APATECH 47, written by Susannah, input on the Tandy 2000, using Multimate, printed using the Apple LaserWriter.

December 11, 1986

We will be on the road from Christmas Day until after the New Year (visiting my family in Binghamton, NY, possibly Dave's aunt and uncle in Pittsburgh, and of course, we hope, Kalamazoo). Therefore, it seems reasonable to start this submission now, while I have access to a computer (or a typewriter or whatever!).

December is more than a third over and the holidays approach! Today Marlene and I baked our Lucia buns for St. Lucia Day, which falls on December 13. (I once had a roommate who had been an exchange student in Sweden, so developed a fondness for Swedish holidays and a taste for Swedish food. Lucia buns are just a sweet yeast bread with raisins, formed in traditional shapes.) Marlene is too little to bring us our breakfast in bed on St. Lucia Day, so I generally bring breakfast to the others (that is, if they want it!).

I suspect some of you will tell us you had to read our last CRUMBCRUNCHERS with a magnifying glass! 7-point type IS a bit small, isn't it? But can you believe that those four pages amounted to 16 pages when written in 12-point?! Anyway, apologies to those of you who encountered eyestrain.

I am still using the Tandy, rather than switching over completely to the Mac. I agree with Guy W.'s comments regarding the Mac to some extent. It took me so long to learn to use THIS machine that I don't really want to give it comepletely up! Besides, Multimate has a spelling checker, which Macwrite doesn't have. I understand from the literature on the new version of ReadySetGo, that it does have a spelling checker, and can function as a quite competent word processor. BUT we haven't received our new version yet!

There do look to be some INTERESTING programs for the Mac out there, though! I read in the November issue of THE ACTIVE WINDOW, the Boston Computer Society's Mac User Group's newsletter, that there is a Japanese public domain program out there called "Teatime." It features a cat drinking a cup of tea, complete with slurping sound effects. This I gotta see!

This newsletter always features a Mac-made cover - the November issue had a turkey (with a Pilgrim hat on) and a turkey, with the message, "Use apples for computers, not stuffing!" The December issue's cover is a very Christmasy drawing of little kids in bed, surrounded by toys and Kewpie dolls. This drawing was from a commercial program, but most covers are produced by BCS members.

December 12, 1986

There has been much talk about English, and the wisdom of its being considered the "official" U.S. language. One of Dave's colleagues is Czech, and she and her son (Albert, who was born in the States) often speak Czech to one another. He finds English class rather boring and doesn't do too well in the subject. At least one of his teachers seemed to feel that the fact that he spoke Czech before he spoke English, and hears Czech at home more often than English, was a reason he was having problems.

I personally feel that Albert's problems in English class are more directly related to his being 16, and interested in other things! But his mom is worried that there may be truth in what his teachers say, especially as she now has a little one (Anna) who is fourteen months old. What few words Anna is saying right now are Czech, and because she spends a lot of time with a grandmother and an aunt who speak no English, her opportunities to hear a lot of English are rather limited. Comments, anyone?

The Christmas season has put everything in my life on hold! I have TWO programs to play music for - the Christmas Eve service and the children's Christmas play. The children's program is this Sunday, and I really do wonder about it. The kids, though they've rehearsed several times, have never all come to the same rehearsal, and the last I heard, few of them knew their lines. This is really incidental to what I'm supposed to be doing, of course - my job is to play background music, three or four carols, and "Here Comes Santa Claus." We're having our last rehearsal for this today.

The Christmas Eve program is much more ambitious, and much more challenging to me, a plodding type person who is totally lost without music in front of my nose. The music director doesn't read music, and learns all her music off records - and often, as you know, the way songs are sung in recordings differs from the way the music is written! She's very innovative and inventive - she's dreamed up an entire new ending to "I Heard the Bells in Christmas Day" - but FRUSTRATING to work with!

December 13, 1986

I watched "The Story of English" avidly while it was on PBS, and deeply regretted missing about three episodes. A colleague of Dave's watched it, and said that it was the only show he'd ever watched that was in English, but had to have subtitles!

Dave's youngest sister Donna just completed a quarter of student teaching at a middle school with a predominately black student population. When we saw each other at Thanksgiving, she complained incessantly about these children's atrocious English. I almost launched into a lengthy lecture on the roots of Black English, but restrained myself with difficulty.

Needless to say, I enjoyed the series immensely (and certainly hope it will be repeated in the future). A series like this, or the study of a foreign language, does wonders for the appreciation and understanding of English. I never really properly grasped English grammar until I took (just for fun) two quarters of conversational German. (I'd already taken two years of beginning and intermediate German, and one semester of German literature, but felt that I was really rusty, so decided to start over from scratch.) Another course that helped me understand English was an introductory course in Old Norse (or Old Icelandic, whichever you prefer)!

We're still eating turkey around here! Yes, we did go up to Dave's folks for Thanksgiving, but we also had a twenty-pound bird of our own, as David couldn't resist $.69 a pound. I roasted it the day before Thanksgiving, and we seriously attacked it as soon as it came out of the oven.

So far, left-overs have appeared in turkey noodle soup, turkey casserole, turkey sandwiches, turkey and broccoli quiche, and, most delicious of all, Hot Browns. The Hot Brown is something of a Kentucky specialty, which was, as I understand, originated at Brown's Hotel in Louisville. It is quite like Welsh Rarebit, but with both turkey AND bacon, and a cheddar cheese sauce. (Our favorite restaurant, deSha's, of which there are at least two - one in Maysville, KY and one in Lexington - serves luscious Hot Browns.)

I remember having a discussion with an anthropologist friend that there is no dish that one can truly say - this is an American food (well, yes, hamburgers, of course, but can we really consider them haute cuisine?). So much of what we eat is somebody else's food - Mexican, Italian, Chinese, French, English - where are our regional specialties that you can only find in certain areas?

Buffalo Wings are available almost everywhere, and the popularity of Cincinnati Chili is spreading too (ten years ago, when I first heard of Skyline Chili, it seemed a strange and mysterious dish, but no more). You can even buy White Castles in the freezer section of Kroger's! (Whether or not White Castles are food is debatable, though I'm sure this remark is really going to stir up some people!)

So far, however, the fame of Hot Browns IS fairly regional, as is Transparent Pie, especially when it is made with a tablespoon or so of sherry! (Transparent Pie IS, however, very similar to chess pie, though I have seen chess pie recipes that call for coconut! In my mom's family, they called it Three-Finger Pie, because you were supposed to use your first three fingers to stir up the filling ingredients! They were all from northwestern Ohio themselves.) Another food that I've only seen in Ripley, but which is probably common elsewhere, is peanut bars - squares of yellow cake coated with chopped peanuts. They are sure-fire at bake sales.

Well, it's time for a few mailing comments!

SHEILA: Good to hear from you again. I am thinking of writing a book about the perils of parenthood! For example, in very few places will you read of postpartum depression referred to as anything more than "baby blues." But postpartum depression is a very real and potentially life-threatening danger for both mother and baby the few few weeks at home. You can very easily end up in the psych ward of a hospital, and be separated from your baby for goodness knows how long! My current problems are far less enormous -the biggest is trying to figure out how to deal rationally with criticism re parenting, some of it quite intense, which I receive from all sides, much of it from my parents and in-laws.

GUY W.: You're right, those smily and frowny Mac faces can be irritating! Today I was especially frustrated while trying to get the LaserWriter to print out the verse for my Christmas cards - the Mac just kept giving me the message that it was "unable to print out this document." After a few tries at getting it to print out, and several "damns" I shut the machines off. Dave afterward explained that this had happened because I'd switched the LaserWriter from "Special" to "Appletalk" AFTER I'd turned it on, instead of before.

If you're interested in learning little-mentioned facts about the Mac, may I recommend the THE ACTIVE WINDOW! It often contains very useful tips and information. Dave also says that POWER USER, which comes as a bonus to MACUSER magazine, is great. One of his colleagues [redacted] brought it in to show to Dave. THE ACTIVE WINDOW is always chock-full of pictures of screens illustrating various programs, etc. - and POWER USER explained how you can get your printed to print out a picture of these screens. You never saw anybod~~s~~y as excited as Dave when he figured out how to do this! (Oh yes, the BCS address - One Center Plaza, Boston, MA 02108.)

ROXANNE: Our 1984 Cavalier station wagon has stood us in very good stead! And I feel more secure in it than I did in the 1971 VW station wagon, which was always making strange noises and stopping for inexplicable reasons (at least inexplicable to me - Dave understood the machine). We passed the VW on to Dave's brother Walt just at the time that we figured it was going to collapse from exhaustion and misuse - that was two years ago - amazingly, it's still running!

Do you have any neat milkless recipes you could share here? Though Marlene doesn't have a lactose intolerance, I cook (especially bake) things for other people who are. I myself am allergic to nuts, and I've frequently spent time being sick after foolishly eating pecan pie (which I dearly love)!

So far we've managed without a washer and dryer, but since I can only find time to make the trek to the laundromat once a week, everyone is in danger of running out of underwear before I go! Proponents of cloth diapers (mainly my mom) made disapproving noises when we decided that Pampers and their ilk were the only answer. But being both lazy and busy, I couldn't see any other feasible answer!

GREG: Now I suppose we'll get jumped all over for including that pseudo-review of STAR TREK; that is, if anybody could read it!

DONNA: Dave used the Mac graphics to good advantage while working on an advertising booklet - our first commission! He made up a little ad for the "Ohio Bluegrass and Gospel Association" using the little musical notes. He also used the little city at the bottom of an article about Licking County, Ohio. I think all the little architectural symbols in the Taliesin font will be very handy when it comes time to arrange our furniture (either in our present house or in a new one, if we ever DO move)!

We've done some furniture rearrangement anyway - sacrificing our dining room entirely - it is now completely office - and getting rid of the living room couch. One corner of the office is the library (novels, children's books, etc.) complete with a rocking chair, which is very nice.

Another danger in choosing children's names is that the name may turn out to be that of an actor or a character on a TV show! One of our criteria in choosing a baby name was that it NOT be a soap opera character - and now when I tell people Marlene's name, I often get the comment, "Oh, you must watch "All My Children"! (Or whatever soap it is - I can't remember exactly. Our TV watching is pretty much limited to stuff on PBS.) All I can say is "Arggh!"

TULLIO: I too enjoy working at home much more than out of it, but getting stuff done is VERY frustrating. Being a mommy is a full-time job in itself, ESPECIALLY now that Marlene has learned how useful chairs are for getting to previously inaccessible places! My spice and herb cabinet has suffered from her depredations - I'm still finding nutmegs strewn all over the kitchen! And did you ever taste walnuts soaked in peppermint extract?! (Alone, they're nothing much, but in chocolate chip cookies, they make the cookies taste of peppermint too!)

December 20, 1986

Well, I suspect that I've rattled on long enough! I have more comments to address to people, but will save them for next time! We still haven't done any Christmas shopping for ourselves, and I really wonder if we will get a chance.

As far as music is going, the Christmas Eve service IS shaping up and promises to be quite nice. There's still more music for me to prepare, because the minister is not content to just have a Christmas Eve service - he celebrates Communion too! This is not too difficult, as I just haul out arrangements of music like "In the Upper Room" and "Let Us Break Bread Together"!

As it will be 1987 by the time you read this - may the New Year be kind to you!

Susannah

Same Old Story

Rolf Wilson
611 W. Hill
Champaign, Il. 61820
(217) ELYSIUM

Mailing comments for Apa-Tech 45

At Home On The Range - I'm pleased to hear that you will have a story published. I seem to know a lot of people now who have a story or two in print somewhere. I guess we all have a story in us somewhere. So why don't I even have a rejection slip to prove I tried?

Transporter Topics - my own argument against SDI goes like this: either the Russians believe it will work, or they don't. If they don't, it does not serve as a deterrent. If they do believe that it will work, they will attack before it is operational out of fear of becoming powerless. ** So you work under pressure too - I write some things for the local Mac users group, and have never STARTED an article before the last day due.

Borborygmus - it doesn't have to be the biggest dictionary. "Borborygm" is in the smallest dictionary I own. But it happens to be Mrs. Byrne's Dictionary of Unusual, Obscure, and Preposterous Words. (Citadel Press, ISBN 0-8065-0498-6) As for The Book Of The New Sun, I feel sure that Gene Wolfe has a copy of, or access to this book. His logodaedalus is a strong indication of it. As for trivia contests, there don't seem to be many people around who want to write them. I suspect that I am mined out for a few years. Why don't you try your hand at writing one? My only suggestions are to research your answer and phrase the question so that no quibbling is possible. Also, ask yourself "Who cares?" about the answer - there must be some reason for remembering that particular piece of information.

Lemonade Stands Fill The Air - you ask "what's a kneebiter?" You might as well ask what a pencilcruncher is, or a rugrat, or a linoleum lizard, or a tricycle motor. As for catching up on reading during my vaction, I did manage to read all the science fiction magazines for the last couple of years or so, making me well qualified to vote for the Hugos. Then I missed the deadline...

Amorphous Abstractions - about the Secular Humanist Revival Meeting -- it was a lot of fun. It doesn't take itself seriously, and Card does a GREAT job of imitating a revival preacher.

Twenny Minutes Outta Yer Future - I take issue with your statement that "This zine is written in the official language of the State of California." After careful perusal of your submission, I conclude that you wrote in English, NOT Californian! Your token inclusion of "I mean, like, uh, someone's tryna tell me somethin', ya know?" does little to obscure the overall literary qualities of your work.

Mailing comments for Apa-Tech 46

At Home On The Range - I remember hearing that some of the best people at playing "splatball" or similar games have been elderly grandmothers with the patience to conceal themselves for LONG periods of time and wait for the hotheaded youngsters to conclude that no one was around, and come charging for the flag...

Amorphous Abstractions - many program on the Mac let you cancel an operation by using command-period. By "command", I mean the "cloverleaf" key, or "splat" as Mike Bentley calls it. Hold it down along with the period key. It make take a few seconds if the program is in the middle of something. This is by no means universal, but it appears in a lot of programs even if the documentation does not say so.

Life on the Mason-Dixon Line - no, our house did not cost $100,000, or even nearly that much. Seeing that we only had a down payment of about $2500, the only reason we got the house we did was the fact that we had no debts. It does seem strange that older homes in this area go for much less than new ranch-style houses that were not as large or nearly as nice. This place may be 85 years old, but I think it will be standing a long time after most of the "things" I see them building today. As for meeting pros, most of them do seem to be approachable (I haven't tried Harlan Ellison or Jerry Pournelle yet) but respond better to comfortable situations. I, and friends of mine have had very good luck in arranging to talk to authors by buying them lunch. They get to sit down in a quiet place, and get a free lunch besides.

Invisible Starship - well, for those who have a 68000 machine, but don't know Japanese, could you tell us what *Shirimasen* means? I don't suppose I will be learning any languages soon. I know enough Swedish to listen to a simple conversation, and could probably struggle through a visit to Sweden. Actually, it would not be that hard - everyone I met in Sweden when I visited there in 1972 spoke excellent English. I think my trouble is that I don't have enough patience for those skills that take a lot of practice to achieve even a minimal skill. Learning a language, or playing most instruments is that way. In comparison, although you can spend thousands of hours learning difficult juggling tricks, it only took me 2 days (many people are faster) to learn enough to enjoy and even impress the easily-impressed. In reference to your comment to Guy (yes, I actually wrote that out) if your saw does not cut your plank straight, you get a better saw. Seriously. Rip fences, hold downs and power feeds do the job much better than any mere human. A better tool (or better program) can probably lay out a page better than most people. With wood or with ink, the artisan is not out of business, but the average person is outclassed. I think this works to our advantage. If I had to make a bookshelf with only the tools available in 1800, the finished product would be far inferior to what I can accomplish with the tools I have now. Hmm... I like to consider myself at least halfway educated, but I admit to never having understood what to do with "it it's its' " and some other little details like that.

Again Mostly Mailing Comments - actually any parties that I throw are mostly for fannish types. I think part of my problem is a reluctance to schedule events for people.

Up Against The Wall of Science - don't worry, no one I know has matching place settings or matching chairs for 13. Just recently did we buy some more of the china pattern we registered for our wedding. We only got 2 place settings - most of our friends had more imagination. So you had trick-or-treaters at Halloween? We had about 5, and I was starting to believe that the entire idea was dying out because of parental fears of poison and razor blades.

I suppose the same people who felt no sympathy for me for being forced to take 2 months of vacation will not be any more moved by my mostly boring 2 week trip to California. My new job sent me out to take a training course on ARC/INFO, a geographic mapping system and database. This happens to be something I am actually interested in. So why should I be bored? Well, half the class had never used a computer before. I'm not saying that any of them aren't intelligent. But I've used a database before, I've used a graphics terminal, and I've even written a very simple mapping system. So nothing in this course gave me any trouble. But it was all new to some of them.

Redlands, California is at the easternmost end of the Los Angeles basin, near San Bernadino. The first thing I noticed after arriving late at night was that there were lights far above the horizon. It took a moment to think of moutains. I had all of Sunday before classes started, so I dropped in at A Change Of Hobbit bookstore. 85 miles is in the neighborhood, after all. Their selection of used books and magazines is not that large, but their strong point is that they buy everything, and you can find more recent, but obscure works.

Some time back, I may have mentioned that I would eventually inherit some money from some distant relative. Well, it took 3 years, but it finally happened. Of course, most of it went into the renovation of our kitchen downstairs, but so it goes. The kitchen itself is waiting for me to finish the insulation and wiring before we can put up the walls. I have no idea when it will be done. I can't even get Mary to help - she has now started working for the Post Office, and has less time than I do. This being the start of the Christmas rush, I expect to see her again sometime in February or so.

One toy we did buy was a new camera. A Fuji TW300, which ranked tops in Consumer Reports for auto-focus cameras. I call it the "Macintosh of cameras", because it is so easy to use that there is really very little that you could do wrong with it. You don't have to focus, you don't have to set the exposure, you don't have to set the film speed, you don't have to wind it and you can't lose the lens cap. Soon, I may find out if it takes good pictures.

Speaking of pictures, I just made some copies of our wedding pictures to give to various people like my mother, Mary's mother and Rose, who took the pictures. Well, I was four and a half years late, but I did get around to it. Just one of those things to cross off the little list I have of things to feel guilty about. I have no idea what I would ever do if I completed them all...

Change of subject. Composting. I get some garden catalogs, and they will gladly sell you fancy bins and devices for hundreds of dollars to make compost. Of course, if you are not in a hurry, you can just get some close-spaced wire fence, mount it in a circle and throw stuff into it. Each fall, I throw all the leaves in, which comes to a lot of leaves. But I had room for some more, so I started raiding my neighbors. Most of them had carefully bagged all their leaves and put them out front for the city to come take away. Convenient. But it was funny to see one old gentleman come out in obvious puzzlement as to where his leaves had gone. It was Sunday, so the city would not have taken them, and he could not understand why anyone else would.

For the first time, I got involved in something as a homeowner. The section of town we live in has a lot of older homes, and a lot of people just like us have moved in to fix them up. This section of town is zoned to allow apartments, and all these people with newly renovated houses would hate to see apartments take over. I realize that the space that our house sits on could be turned into an apartment building with twelve to twenty apartments. From a pure financial point of view, it makes more sense. But it makes a different kind of neighborhood. So the city held a public meeting to see what people thought about "downzoning" the area to prohibit the building of any further apartment buildings. Predictably, all the house owners were in favor, and all the owners of apartment buildings were opposed. I have some hope - there were over a hundred people at the meeting, which is unusual. Most of the apartment owners reacted as if downzoning would make them tear down the buildings they owned, which it would not. But I guess it does reduce the value of those buildings, because their resale value goes down. I also heard that when an area is downzoned, there is sometimes a rash of "mysterious" fires in apartment buildings as the owners get their money out of them.

While at Windycon, Jim Detry took me to an interesting computer store, by the name of 48th State Computer. Everything is remaindered, purchased from computer stores all over the country going out of business. Across the window in front is painted "Our prices are too low for us to wear suits". I bought a couple of games, an uninterruptible power supply and a spreadsheet. I never expected to need a spreadsheet, but at $19 for a $295 product, I can make use of it as a general mathematical tool. They didn't have any hard disks. I'm looking around for one now, as the prices in the Macintosh market have finally come down closer to what the PC market is. I nearly blew up the UPS, by forgetting that it was hooked into a certain power strip, which I carelessly plugged a hair dryer into while putting some heat-shrink plastic on our windows. The UPS is rated for 90 watts, the hair dryer 1200. I replaced a fuse, but it still seemed sick until I let it discharge, and then plugged it in again. Perhaps one of you electrical types can explain that.

We were looking at some security devices for small computers at work. One was some cables and 4" by 4" adhesive pads to attach to each piece of the computer. I was dubious about how secure they were, so I suggested that they buy one, and let me try to defeat it. It sticks on quite nicely, with much more holding power than you could pull off. So the next day, I brought a screwdriver to work, one of my heavy-duty ones that double as pry bars. It took me a few seconds to get the tip under one corner, then SPROING! 15 second "theft". We didn't buy any more of those. I read a book by a professional burgler once - the only tool he used was a sturdy screwdriver. I offered to bring my screwdriver again and test out my boss's new house for security, but he turned me down.

Last year I had the idea of taking a day off to do Christmas shopping, and liked the idea. I did it again this year, but had quite a surprise the next day when I went back to work and found out that the nebulous, in the future move intended for our office had been scheduled for TODAY! Eek.

I usually have trouble figuring out what to get Mary for a gift. Not this year. At Chambanacon, she saw a ring that she liked. I found this out when I walked into the huxsters room and 4 different people told me that Mary liked that ring. I can take a hint when applied with a 4 by 4, so we ordered one. It is a hooded dragon, with this one having emerald eyes. Interestingly enough, this is the same ring that local author Timothy Zahn wrote into his Blackcollar books after he got one. I had real difficulty telling anyone what I wanted as a gift, because I have the habit of buying things when I find that I need them.

For several years we have been making bookshelves, both for ourselves and friends. It seems that each set gets better, both from experience, and from getting better tools. So recently I decided to make several shelves out of oak. Pretty wood, matches much of our woodwork. But it causes some problems that I had never had before. I used to use #4 finish nails on my shelves. When I tried some in oak, they bent like wet spaghetti. Same with #6. I finally got the #6 size to work by drilling PILOT HOLES for my nails! I get the feeling that none of this is going to fall apart soon. I also tried putting an angled base on this set, to make them more stable. However, this required making a 45 degree cut through a 2 inch thick piece of oak. Not something to try on an underpowered saw. Even with 3 horsepower it was slow going.

1987 looks like the year we buy a second car. The '79 Chevette has done everything I ever asked of it and more, but we probably need a newer one as well as sometimes needing two. Probably when the April "car issue" of Consumer Reports comes out, we will sit down and make a list of every station wagon and small van they like and start comparing. This will be only the second car I have ever bought. The first time, I walked in, asked how much it was and wrote a check. Since then, I have learned better. The idea of a price not being fixed somehow still bothers me, though. But I plan to read up on some of the "tricks and traps" that car salesmen use, and even get some pleasure out of walking out on them if they get too slimy. Seems like one of the few socially acceptable ways to be nasty to people...

Well, I suppose that I will have seen many of you at Ishercon before you read this, so maybe you will hear some of it there first. Octopus, everybody!

Down to the Sea With Chips

Al Duester
December 1986

Ah, such a sound the psychic whip of guilt doth make. I suppose I should write something after sitting back and absorbing copies of ApaTech for well over a year. So, here I go... Uh, yeah, right now....... I can already tell you're all going to be disappointed by the size of this contribution. Maybe this will actually get in before the axe falls.

Somebody please change the zip code for me in the address file!! I've mentioned it two or three times, and it's still incorrect - the right one is 02543. Everything else is correct.

Over the past year I've been retargeting my writing towards a newsletter and user's group I'm running for the DX7 synthesizer. And now Yamaha goes and discontinues it... I've got about 70 members in it right now. I got the first real issue of the newsletter out the beginning of June. Lots of different voices, info on the synth, and all real boring to anyone who doesn't use one so I'll shut up about it.

Bonnie and I are splitting up. Yeah, still. We've been splitting up for about a year now, so don't hold your breath! I guess it's better than roaming the streets. She now "lives" in Boston during the week and comes down to the Cape on weekends to pack, etc. You get one guess as to how much packing vs. how much etcetera she's getting done!

Major dietary change #1: I finally managed to get a microwave oven at work to heat lunch up in. For years, no-one's been interested in coughing up the bucks to get one. My recent strategy worked, though. I bought a $99 special, figuring that it was cheaper than buying food at the expensive deli/food store across the street from the lab, and would be a good fall-back. However, after about a month of me bringing in lasagna, chicken breast with apple/dill glaze, Shrimp scampi, and other wonderful aromatic lunches the rest of the folks decided that maybe pitching in on a big microwave for the lab wasn't such a bad idea after all. Now my little one is at home, well used. I also spent a bit on microwave reheatable containers. I tend to either like to cook or hate to cook. Very little grey area here. The microwave is great because I can cook for five hours, and be set for two weeks of lunches and those times when I'd rather starve than cook something.

Major dietary change #2: I've been reading the Pritikin books, and decided to try the dietary approach that he discusses. I've been cheating (failing) like crazy if you go by the books' instructions, but my cheating doesn't circumvent the intent of the book too badly - to reduce the fat, salt, & sugar drastically and protein quite a bit. So far, I've lost 8 lbs. in 3 weeks (and gained back 3 of it on Christmas goodies). You eat mostly complex carbos (veggies, whole grain products). After reading the books, it becomes apparent just how much fat there really is in the average American diet - just try eating along the Pritikin guidelines and you find out! No-no's include nuts, chocolate, olives, anything cooked in oil, avocados, egg yolks, cheese, and most everything else that tastes "good". On the other hand, fresh homemade whole-wheat pasta is ok, and is just yummy.....

The 20th of January I'm going to Bermuda to do some more testing and development work on the Fast Profiler. The amount of crap we have to go through to ship a ton of scientific gear out of the country is amazing. We lost the first profiler back in July (as you'll find out about in "Cap'n Al Goes to Sea, Book 4" in a future issue of Pyro). Now that we're getting the second one built, it's time to test it some more. Bermuda has deep enough water only an hour or so from shore, so for repetitive trips from the lab to ocean, it is preferable. Woods Hole is about 15 hours from deep enough water. I haven't decided if Book 5 will result from the cruise, or if I'll merge it with Book 4.

With another Boston Worldcon looming on the far distant horizon, I thought I'd pass along these tips on Boston Driving for those of you planning to drive in the area:

1) Obey traffic lights. Green means go, Yellow means floor it, and Red is open to interpretation.

2) Don't use those silly directional signals. The flashing lights just confuse other drivers.

3) Time is money. Don't waste it by letting the other person get in front of you.

4) The horn is there for a purpose. Use it often.

5) Traffic always seems the worst when you pay attention to it.

6) Big is best.

7) When approaching a dangerous intersection, increase speed. The danger will pass faster.

8) When turning left onto a busy road, pull out as far as you can. This saves time.

9) Keep your windows closed. Other driver's remarks can be distracting.

10) If you're only going to drive 70, do it in the right hand lane.

11) The Cardinal Rule: Mind your own business and that of your car. Let other drivers mind theirs.

12) Leaving too much space invites other drivers to pull in in front of you. Remember that the maximum safe following distance is always less than the minimum.

(from The Woods Hole Weekly, now defunct)

The construction on the Hynes auditorium in Boston is progressing, and it looks like it may actually be finished before the Worldcon happens! Let's all hope so, as it contains a lot of the function space for the con. The only possible alternate would be to bus everyone across town to either Bayside Expo Center or the Commonwealth Pier for the huckster room & art show!

It's Tuesday Dec. 30 at the moment (Note: this statement only valid for this paragraph). I just got back from driving to the music dealer a few towns over. Tonight is also the first night that it has snowed this year. The roads were messy, but my FB-01 came in, and after waiting for it for months, I wasn't about to let it sit at the dealer's. What you ask, is an FB-01? Three years ago Yamaha introduced the DX7, and it blew away the music industry. It was a full blown digital synthesizer for 2 kilobucks. Now they've taken their digital technology, and brought out a little expander box for $350 that is unbelievable. It doesn't have a keyboard of its own - nowadays you pick a keyboard controller and hook it up with a serial interface to the synthesizer of choice. But it obsoletes just about everything else available for under $1000! Since most of you aren't interested, I won't go on about it, but Guy and any others into synth gear should run down to their local Yamaha dealer to order one. It will probably not be necessary to bring cash or credit card, as dealers cannot keep these things on shelves - I grabbed mine 2½ hours after it came off the UPS truck at the dealers. For more info on the "Best Toy of 1986", gimme a call.

I'd like to spend more time chatting, but this contribution is fighting for time and deadline with my application to NASA for Mission Specialist. Guess which I'm putting on priority?

On some of the following pages I've reprinted a bunch of stuff that I've clipped out over the past year that may be of interest, and that I haven't seen reprinted before. Most of it is about the Challenger disaster, and is from EE Times.

Last year (or the one before) I printed some stuff on the cycloid drive system of the Knorr. I've uncovered a few more pictures in a back issue of Oceanus magazine. This may help clarify matters, so I'll reprint it too.

Mailing Comments:

Ish #46 Sheila: Yes'm. This time there were only two satellite vans outside my office window. However there were four vans with martian death ray type microwave transmitters for the Providence & Boston news services. There's a National Geographic videotape out about the Titanic now, available in fine stores nationwide, and the WHOI stockroom.

Guy: The reunion sounds interesting, but I doubt there will be many PFRCers up there in the middle of the summer -

or had you forgotten that mysterious thing called summer vacation? Keep me posted - I'd like to try and make it assuming the July cruise gets back by that time. It's been a long time since we tried shooting lasers from Brockway to the fire tower.

Rod: Re. yr Ct. Greg: Then again, "Flight Dynamics" brings to mind a little plane with lots of different size arrows holding it up in the air, flying across a gloomy chalkboard sky......

Greg: On your invisible dirigible mooring mast, silly.... And thanx for the stickers

Issue #45:

Greg: Wow! Technology marches on. Wasn't too long ago you had to use glue & nails to assemble furniture, then staplers came along. Now we can assemble our armored battle rockets with staplers. See, SDI spending has already started to pay off!

Linda: Every time I read something on a foreign country I get to thinking how I really don't have any interest in visiting there. Of course, I felt the same way about Atlanta, and managed to get there.

Guy C.: Have you upgraded to RSG 3.0 yet? I've been typing a letter to Manhatten Graphics over the past two months, and have come up with about twenty minor problems that need to be ironed out. For your picture of Mercury - did you rip it out and use Thunderscan on it, or have you found a cheap digitizer for the Mac that hooks up to a video camera? I ask because we'll be needing one here at WHOI in the next year when we get going on the instruction manual & profiler operating software for the Mac.

Barry: Ah, the wonderful space museum in Jackson. We never did get into the place, but I had a wonderful time crawling around on the F-1 engine out in the yard, getting a look at all the parts that I wouldn't have been able to get to to see had there been any employees about.

Bonnie: I fractured the fifth metatarsal in my left foot playing softball this past summer. At least I was coming across the plate making a run when it happened. The Ocean Engineering department team (my team) wasn't too happy about it though, as I was playing a stand-in position for the Geology & Geophysics team on a day when we weren't playing. Our perfect record came apart a week later too. Little things make you feel important. Then the intern at the hospital sent me home with an elastic sock on and told me to see someone about my broken toe in a few days. Luckily the concertina player in the Woods Hole Folk Orchestra (where I play synthesizer for square dances) is a podiatrist, and caught on to what had happened. He came into the lab at 11 p.m. and put on a soft cast while we had a few beers & talked about music. Lucky thing, because after a week, he thought I would have had to have it rebroken & reset. A few days later he put on a hard cast, and then I went out to sea on a cruise. If you want to find out about me hobbling about on a ship at sea on a deck covered with a slippery mix of water and hydraulic oil, one leg in a steel-toed boot, the other wrapped in garbage bags, you'll have to read "...Book 4" // When I sliced into my finger with the bandsaw a few years ago, the doctor (same one as for the "toe" in the ER) didn't want me to look at my finger as he was peeling, prying and sewing. Apparently too many people go into shock seeing the "real me". I wanted to see what the tendons looked like in operation when I used the associated muscles. Some people just can't respect a healthy curiosity..... I would have been all right - there wasn't any formaldehyde in the air to bring on the nausea associated with dissecting pigs in high school biology. // Really missed seeing you at Conclave. Hope that conference was interesting.

Guy W.: So you've got a DX7 - whennareyagonna join my user's group?

Ish #43 & before: I really enjoyed all the stuff that's been coming my way from you folks, but it's a little late to comment on much of anything now!

See you whenever.... Cap'n Al

Aug 4 1986 EE Times

Tape Release Casts Shadows On NASA

By Richard Doherty

WASHINGTON — NASA's sudden release one week ago of audio tape records it previously said were not recoverable is shedding serious doubt on the integrity of the nation's space agency.

It's part of an emerging pattern of efforts to slow the flow of information concerning the Challenger accident, efforts that are stymieing attempts to engineer crew escape options and return the shuttle to space.

At stake immediately is where Congress will place its funding: with a continuance of the manned space program or a fleet of expendable launch vehicles (ELVs). The use of ELVs—many not under NASA control or operation—could change the operation of NASA radically from its pre-Challenger status.

Since mid-March, NASA engineers had tried to recover data from Challenger's surviving voice and data recorders. NASA released videotapes showing the careful efforts being made to wash away any effects of seawater from the half-inch magnetic media. Copies of the tapes were

(Continued from Page 1)

made and analyzed at the Johnson Space Center in Houston (see *EE Times*, March 24, Page 15).

But weeks before the Presidential Commission's report was due, the space agency said it doubted it would have the data available in time for the panel's June deadline.

Subsequent NASA statements said the tapes were likely to contain no recoverable data due to the inability of NASA workers to physically extract the thin tape from heavy corrosion spotting the magnesium tape reels.

Then, IBM Corp. engineers stepped in, lending their expertise by applying chemical compounds that neutralized the magnesium salts. Even after that, in early July, NASA replied to a specific federal Freedom of Information Act request for the taped crew intercom records by saying "such data does not exist."

But on July 28, NASA released a complete crew transcript starting two minutes before launch up to the moment of orbiter breakup 73 seconds into the flight. The voice and data records did provide crew intercom communications and new accelerometer records that were unavailable throughout the Rogers Commission's investigation.

Eleven days before, at a House Science and Technology Subcommittee hearing on the return to space, Chairman Rep. Bill Nelson (D-Fla.) attacked NASA representatives for their lack of technical preparation to answer questions asked by the subcommittee members. Moreover, Nelson lambasted the quality of technical support the subcommittee was receiving from NASA.

For example, earlier presentations by NASA to House and Senate subcommittees were made with medium-resolution video tapes. Higher-resolution film, showing details of the shuttle breakup, only became available to the subcommittees after the conclusion of the Rogers Commission report.

Trickling Video

NASA impounded photographic and video cameras from third parties the day of the Challenger launch. It was 10 days before the first crude films were released showing the solid booster flame plume that triggered Challenger's demise. Nine weeks passed before slightly higher resolution, slow-motion videotape of Challenger's breakup was released.

It was nearly four months after the accident before high-resolution 70-mm films were made public. That was only after TV network pressure—using the Freedom of Information Act—pried them from NASA control.

Months ago, NASA's visual camera team, headed up by engineer Dan Germany, had available 70-mm film records. That film produced visual tracking records with enough resolution and clarity to show the crew compartment emerging from the fireball left by Challenger's exploding external tank.

Until that film's release, NASA never reversed itself on its position that the Challenger crew compartment was consumed in the initial fireball. With its announcement last week of the audiotape evidence, NASA referred to radar and film records that reveal the crew compartment survived a two-minute, 45-second plunge into the ocean.

Adm. Richard Truly, a former astronaut, said he hoped the disclosure of the audiotapes last Monday would "close this chapter of the Challenger loss." But attorneys for the astronauts' families, Nelson and his subcommittee, and a frustrated engineering community are wondering how much more evidence has not yet come to light.

For example, *EE Times* learned last week that in addition to the half-inch data and flight recorder tapes from which the crew conversations were recovered, each crew member was entitled to use a personal cassette recorder in flight. The recorders were supplied by NASA for astronauts to make personal records of their own experiences aboard the shuttle.

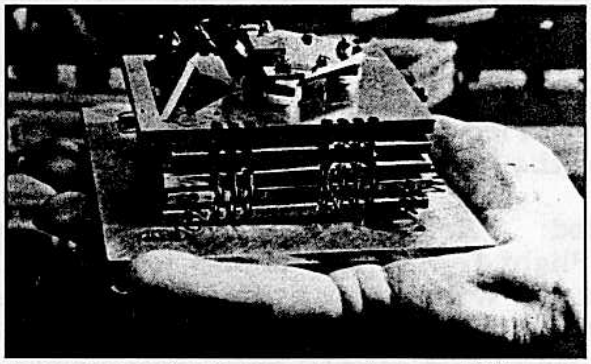
According to a NASA spokesman, one cassette recorder was recovered from the crew compartment on the ocean floor. The NASA report says the recorder was still sealed in its protective compartment, and that the tape was too damaged to be replayed. The fate of the other cassette recorders could not be learned from NASA officials.

According to flight procedure, the crew members are supposed to stow their recorders during ascent. However, another NASA spokesperson, Barbara Selby, indicated that these recorders were considered personal property. She could not say whether the astronauts had stowed their recorders, or if the recorders might have been in use and retrieved as personal effects.

Microscope Work Wins Pair Nobel Physics Prize

By David Zielenziger

NEW YORK — Hours after winning the 1986 Nobel Prize for physics last week, the two IBM Corp. laureates admitted that their citation, for inventing the scanning tunneling microscope, came in a field they knew little about before they began their pioneering work in 1981.



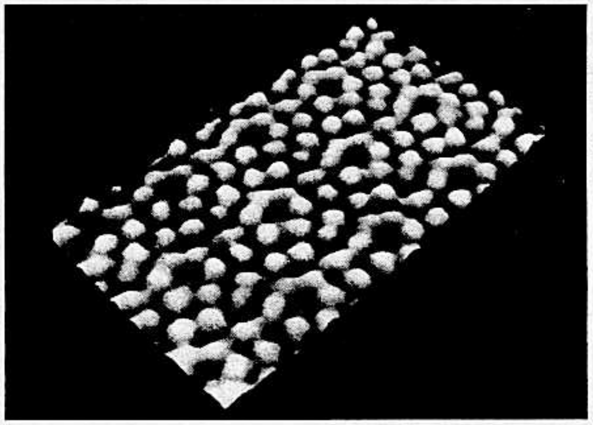
The scanning tunneling microscope, shown here, earned IBM researchers Gerd Binnig and Heinrich Rohrer a share in the Nobel physics prize.

"We had no background in microscopy," acknowledged Heinrich Rohrer, 53, a Swiss who works with his partner Gerd Binnig, 39, a West German, at IBM's Zurich Research Laboratories. "The whole project came about after just a couple of hours of discussion."

The pair are the first IBM researchers to win the Nobel prize for work conducted within the computer company's research department. Leo Esaki, a Japanese who won the physics prize in 1973, for developing the tunnel diode, joined IBM after he had won the award, which is valued at about $290,000.

Ironically, while Rohrer and Binnig won their Nobels for work that was new, they shared it with another microscopy pioneer, Ernst Ruska, 79, another West German, who invented the electron microscope 55 years ago. Ruska, a physicist with years of teaching experience at the Technical University of West Berlin, had also worked for Siemens A.G., West Germany's biggest electronics concern.

The Rohrer-Binnig microscope works basically by passing over a surface, maintaining a constant voltage between it and the tip of the microscope's metal probe. In effect, it moves up and down the so-called atomic "hills" and "valleys," transmitting data from these small movements to a computer for three-dimensional processing.



The scanning tunneling microscope shows atomic structures on a surface—here, the surface atoms of silicon, magnified millions of times.

The device has been used to determine the confusing crystal structure of silicon as well as many other elements whose precise composition had been only theorized but not seen. "We're not really seeing atoms, we're seeing atomic structures," noted Binnig. "But we're able to see those structures on a surface as we never have before."

The device has already been used for research into future means of building semiconductors and computers, producing light beams for optical computing and for learning about the composition of living cells.

Both physicists have spent years with IBM and have worked in the United States for different periods. Rohrer took his PhD in 1960 in superconductivity in Zurich in 1960, but then immediately spent the next two years at Rutgers University. He also spent a sabbatical at the University of California at Santa Barbara.

His younger colleague finished his doctorate in experimental physics at the Goethe University in Frankfurt, West Germany, only in 1978.

Binnig spent last year at Stanford University and at IBM's labs in San Jose, Calif.

Both physicists won the 1985 IBM Corporate Award.

Sept or Oct EE times

Electronic Engineering Times — Monday, May 19, 1986

Respect

It is strange that Mr. Mhatre uses the Challenger tragedy as an example to support his premise in "Why Engineers Get No Respect" (see *EE Times*, April 14, Page 24). I see this as more of an example of courage than of respect.

Aviation Week stated "15 Morton Thiokol engineers and managers, acting as a group, on Jan. 27 petitioned Thiokol's senior representative at the Kennedy Space Center, Allen J. McDonald, to disapprove the launch of mission 51-L because of serious concerns over the effect of cold ambient air temperatures on the solid rocket boosters."

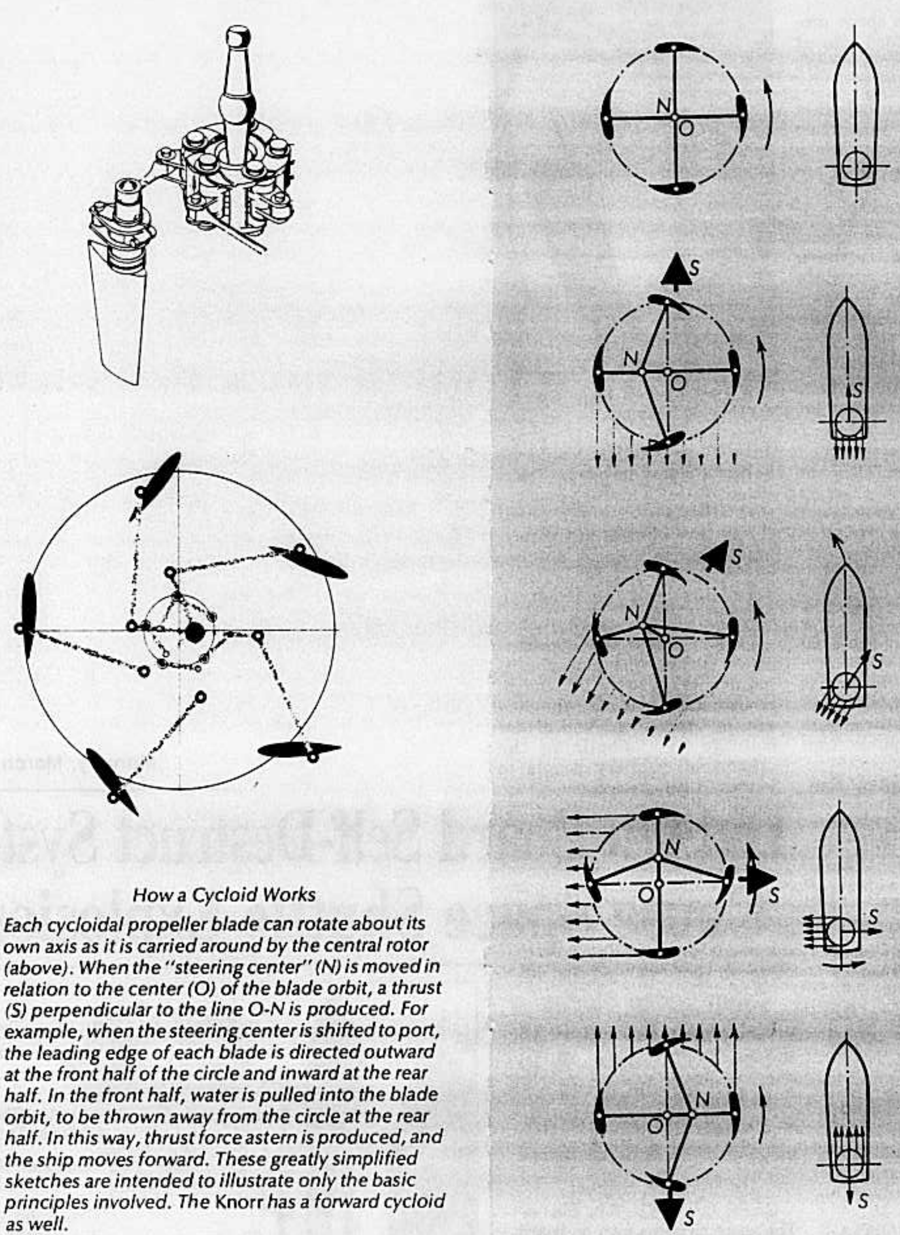
McDonald, an engineer, had the courage to refuse to sign off on the launch. It takes courage to do this because if the launch occurs anyway and is successful, his job is in jeopardy, if not forfeited. However, he considered the safety of the astronauts a higher priority than his own economic well being.

McDonald's superior supported McDonald's position initially. But, after a two-hour teleconference between NASA middle management and Thiokol management, [McDonald's superior] was maced into overruling McDonald and cabling NASA, approving the launch. Evidently, McDonald's superior lacked McDonald's courage. I wonder if I would have sufficient courage if I were in his position.

This was not a case of respect or lack of it. None of the engineers changed his position. Their position was not what NASA middle management wanted to hear, so Thiokol management ignored the engineers and polled only the "managers." Two of the managers reversed their positions and McDonald's superior cabled Thiokol's approval of the launch. Might I suggest that these "managers" should be labeled "managees." My fondest hope is that the district attorney and people of Brevard County, Fla., the site of this tragedy, arraign, indict and convict McDonald's superior, the one person who covered NASA's butt and made this tragedy possible, of manslaughter. He could then forfeit a few years of personal freedom as partial atonement for the destruction of seven lives.

In conclusion, I ask *EE Times* to determine the job status of McDonald and his superior. If my worst fears are realized, then the manslaughter arraignment is essential. Otherwise crime does indeed pay.

James P. Gray
Senior Engineer
Raytheon Co.
Marlborough, Mass.



How a Cycloid Works

Each cycloidal propeller blade can rotate about its own axis as it is carried around by the central rotor (above). When the "steering center" (N) is moved in relation to the center (O) of the blade orbit, a thrust (S) perpendicular to the line O-N is produced. For example, when the steering center is shifted to port, the leading edge of each blade is directed outward at the front half of the circle and inward at the rear half. In the front half, water is pulled into the blade orbit, to be thrown away from the circle at the rear half. In this way, thrust force astern is produced, and the ship moves forward. These greatly simplified sketches are intended to illustrate only the basic principles involved. The Knorr *has a forward cycloid as well.*

Each blade of a cycloid can turn on its own axis as it spins around a common track. Once the clutch is in, the blades start churning water like an eggbeater, but the ship will not move until the pilot increases the pitch of the blades. Since the blades can thrust water in any direction, the *Knorr* can even move sideways.

But the main advantage of the cycloids is their ability to hold the ship "on station" during scientific work. The *Knorr's* cycloids can hold the ship steady on any heading and the automatic pilot can be set to compensate for the current.

Jonathan Leiby, the Oceanographic's naval architect, compares cycloidal ships to helicopters, contending their ability to "hover" compensates for their lack of speed or economy on long-distance cruises. The *Knorr*'s crew has had some difficulty with the cycloids; on a North Atlantic cruise they rigged a sail on the bow to make steering easier until the ailing aft cycloid could be repaired in Scotland with parts flown in from Germany. But Leiby blames the breakdowns on design problems rather than on any drawback inherent to cycloids.

The *Knorr* was the first cycloid-powered research ship to be built in the U.S. Her sister ship, the *Melville*, is operated by Scripps Institution of Oceanography in California. Some German and French research vessels are equipped with cycloids, which were developed in Germany and are used extensively in European tugboats and ferries.

"They should never build another research ship without cycloidal propellers to give it the maneuverability we need," Hiller says. Although he would like to see the *Knorr's* heating and air-conditioning systems improved, he is generally pleased with the way his ship handles. "First of all, she's a small ship in a big ocean," he says. "She rolls heavily in a beam sea. But in bad weather we just slow down and head into it, and she handles very nicely."

Once, between New Zealand and Antarctica, Hiller had occasion to worry about the high seas. "What they were telling us on the radio reports was nowhere near as bad as the 70-mile-an-hour winds we were having," he recalls. "We had to heave to for a whole day and ride it out." On the same cruise, ice was another cause for concern:

> *From what I have seen of the ice so far this season, I have no intention of attempting to plow through even the softest pack ice. On our second run south, a couple of weeks ago . . . we encountered the ice pack . . . and already the edge was breaking up and some pretty large chunks were broken away and drifting north. We eased our way . . . in amongst the loose pack ice and did a CTD (Conductivity/Temperature/Depth) station, but even there some of the ice was rafted up to a foot or 18 inches thick. What looked like soft, mushy ice turned out to be hard and heavy with razor-sharp edges honed by the seas. This ship is not ice-strengthened to any appreciable degree, and I think it would be foolhardy to get in too . . .*

From Oceanus Vol. 25 #1 Spring 1982

Astronauts Complain To Probers

Ask For Safety Panel And Review Of Self-Destruct System On Shuttle

By Richard Doherty

WASHINGTON — Astronauts complained last week that they're flying with 1970s technology, computers on mission simulators no longer are made and mission profile software arrives too late for the spacemen to learn it.

They rattled off their gripes to the Blue Ribbon Presidential panel investigating the Jan. 28 space shuttle disaster.

The commission must soon wind down the probe and present its report, so its members listened hard to the people who have to fly in space.

Led by chief astronaut John Young, the astronauts made other points:

- Review the self-destruct explosive Range Safety System (see *EE Times*, March 17, Page 1). Young said a verbal agree-

system after ejection seats were removed from early initial flights, but it "never happened."

- Create an independent safety panel to enlarge communications among NASA divisions.
- NASA payload manifests have been delayed with a faster-paced schedule, so there isn't enough time to test critical trajectory software for onboard computers. Astronaut Robert Crippen says that at times software has arrived less than a week before liftoff. That leaves a pilot little time to gain experience with the mission profile. Profiles change with varying loads.
- Astronauts do not agree among themselves that it is hopeless to improve the possibility of astronaut bail-out during critical liftoff times. Young said that given time, money and talent, additional escape

replacement orbiter and, possibly to the surviving fleet of three. "It won't be cheap," Young said.

Astronaut Bob Crippen had a different view. He thinks any additional escape system would be of minimal help, and might add "another system likely to fail." Panel chairman William Rogers seemed interested in pinning down the cost of such an escape system, so the panel might lend its weight to its consideration by President Reagan and Congress.

- Panel member Richard Feynman, a physicist, criticized an apparent NASA policy that winks at possible failure. If a suspected critical item worked well after a few flights, NASA scrutiny of any potential danger diminished when no problems emerged. "The (shuttle) has flaws; it's not operational," Feynman said.

Astronaut George Abbey, director of flight crew operations, said that he bets "engineers know all the problems right now." But, he added, think of this scenario: If an engineer reviewed a part and told his boss it wouldn't work and could harm the shuttle, the boss might say, "it's OK. It flew 60 flights," Abbey said, implying it wouldn't be changed.

"Don't make hasty fixes," said astronaut Henry Hartsfield. "The cure must not be worse than the illness." He said the shuttle is not operational in the traditional sense. To those who fly it, it will never be routine.

"The space shuttle is the most fantastic, magnificant flying machine in the world," Hartsfield added. He wants to reevaluate the design, and said "critical areas that can't be re-engineered must have quality control boosted."

Astronauts said they want a return to labeling the Space Transportation System—the shuttle program—as "developmental." That includes putting back on the sensors that were removed after the first flights Young and Crippen made in the early 1980s.

Astronaut Paul Weitz also testified. Former astronaut Neil Armstrong, first man to walk on the moon, and active astronaut Sally Ride are on the panel.

Hartsfield said his opinions were his own, but most other astronauts shared them.

He argued that an independent safety panel, reviewing NASA operations, is needed. He said a panel with no ax to grind could improve flight safety via communications. Rogers agreed. He said the presidential commission is considering recommending formation of such a panel after the investigation ends. He also asked astronauts to suggest guidelines.

NASA Asks For $6 Billion

Wants New Shuttle, Expendable Launchers

By Richard Doherty

WASHINGTON — A major, multifronted lobbying offensive was mounted on Congress last week to keep the river of money flowing into the space program.

Vice Adm. Richard Truly, new boss of the space shuttle program, argued that money must be approved swiftly to replace the destroyed Challenger.

He also made a pitch for funds to buy a set of 10 expendable solid booster rocket launchers to launch heavy, unmanned payloads. Since the Jan. 28 Challenger disaster, large Defense Department payloads have been grounded.

The price for the whole package would run $6 billion. Previous estimates to replace the orbiter and redesign the solid rocket boosters ran $3 billion.

Truly testified before the Joint Senate Appropriations Committee on Defense, as did Air Force Undersecretary Edward Aldridge Jr.

"We built Vandenberg (Air Force Base, Calif.) for polar orbits," said Aldridge. "We must have that facility operational."

Truly and Aldridge argued that NASA needs the expendable boosters to maintain defense aspects of the space program. They also argued against shutting down Vandenberg's shuttle launch facilities.

Emotional pleas on behalf of the space program were made before a Senate appropriations committee on NASA space appropriations.

Testimony was given by columnist Jack Anderson, teacher-in-space alternate Barbara Morgan, and folksinger/space activist John Denver. They argued that the open U.S. space program has generated priceless good will around the globe.

They said the spinoffs from NASA space research are invaluable.

Anderson said he approached President Reagan last fall about starting an exchange program for young American and Soviet astronauts. That was presented to Soviet leader Gorbachev.

Appropriations committee member Sen. Frank Lautenberg (D, N.J.) said that few know that more than half of the $120 billion spent on the space program in the last 25 years was devoted to defense payloads and missions. He praised the speakers' efforts to raise public consciousness of space.

Vice Adm. Richard Truly: Give us expendable boosters.

Committee chairman Sen. Jake Garn (R-Utah) said he believed the program was laced with "a two-to-one ratio" of misconceptions about the nature of most space payloads. He said most defense payloads are communications satellites and verification (spy) satellites.

Denver closed the appropriations session with a song written in memory of the late teacher Christa McAuliffe, who died aboard Challenger, and of her courage in symbolizing the dreams of ordinary people to journey through space.

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Europe Takes Another Step Toward Manned Space Lab

By Roger Woolnough

PARIS — Europe's Columbus program, which plans to put a manned laboratory into orbit as part of the U.S. space station, has taken a further step forward with an agreement between the European Space Agency (ESA) and the National Aeronautics & Space Administration (NASA). The agreement relates to the preliminary design of the hardware elements, but does not cover its actual development.

NASA's manned space station might be launched by 1993. An offer by President Reagan for Europe to take part in the program was accepted by the 11-nation ESA at the beginning of last year.

ESA's studies are now part way through a stage known as Phase B. One of the agency's activities under the latest agreement with NASA will be the preliminary design of a permanently attached pressurized laboratory module. This will mainly be used for materials science, life science and fluid physics research.

The pact also covers preliminary design of an unmanned polar platform, intended for launch by the European rocket, Ariane V. This platform will be primarily for earth observation.

Studies relating to both these projects will extend through early 1987.

Earlier negotiations on Columbus between the ESA and NASA nearly came to grief because the Europeans wanted to design a manned module which would dock on the space station, but be free to navigate independently. ESA backed down on this last April, but the latest agreement goes some way to meeting Europe's wishes.

As well as the permanently attached module and the polar orbiting platform, the ESA is to conduct preliminary design of a man-tended free-flyer, which will take the form of a pressurized module and resource module. It will be for international use, primarily for research which requires an undisturbed microgravity environment of long duration. As with the permanently attached module, this research will be in the fields of material sciences, life sciences and fluid physics. In addition, ESA and NASA will jointly study the man-tended free-flyer. This study will concentrate on user requirements, and will relate it to the space station as a whole. It will provide a basis for determining the utility of a man-tended free-flyer to the space station system. The study is to be completed by January 1987.

ESA will also investigate a co-orbiting platform, based on an enhanced version of Eureca, the European retrievable carrier.

Monday, March 24, 1986

Did On-Board Self-Destruct System Cause Space Shuttle Explosion?

Other Space Stories
- **Recorders Probed, P. 15**
- **How RSS Works, P. 14**
- **Space Station, P. 14**
- **Europe's Plans, P. 15**

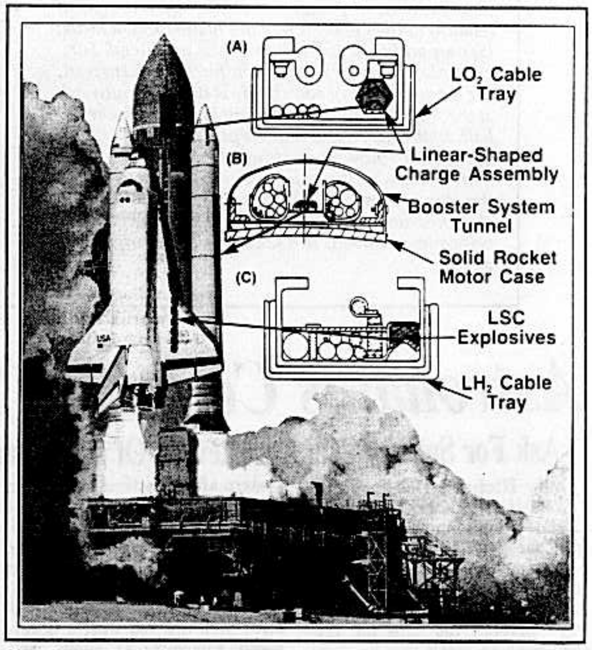
By Richard Doherty

CAPE CANAVERAL, Fla. — The space shuttle's own on-board destruct system could have blown it up, says a former electronics test engineer for the spacecraft's pyrotechnics. The destruct mechanism is intended to abort rockets that might veer off course and land in populated areas.

NASA documents show the nearest charge of the powerful explosive HMX was placed 13 to 15 feet from superheated flames escaping from a suspected leaky right booster seal. The documents also show that the HMX (cyclotetramethylenetetranitramine) destruct explosive, designed to be triggered remotely by radio signal, self-ignites at a temperature of 350°F. NASA has estimated the temperature of the escaping flames at 6,000°F.

Electrical engineer Val Shires thinks the explosives in the on-board destruct mechanism were ignited thermally. Shires was section chief of test engineering for shuttle destruct systems electronics from 1981 to 1982.

When shuttle launches began, Shires was employed by United Space Boosters Inc., which was under contract to NASA.



Shuttle pyrotechnic devices could have been seeds of destruction. Details show positions of linear-shaped charges (in red.)

EE Times inquiries into the disaster have centered on the spacecraft's electronics.

Last week, Tom Gracom, a Lockheed Corp. lead electrical and range safety systems engineer, told *EE Times* at Kennedy Space Center that no changes were made in shuttle pyrotechnics since flights began in 1981. NASA electrical engineer Tom Mullin agreed. Lockheed holds the NASA ground-preparations contract for shuttle launches.

NASA does not normally say much about the remote-controlled, space shuttle destruct system. The Range Safety System (RSS) is an extension of a policy established long before manned space flight began 25 years ago (see related article, this issue,

(Continued on Page 14)

Did Self-Destruct System Blow?

Expert: Flames May Have Ignited Shuttle's On-Board Explosives

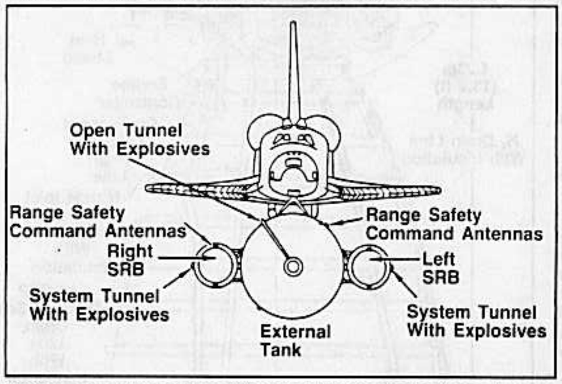
(Continued from Page 1)

Page 14). The mandate of RSS was to ensure that no rocket-powered system would run out of control and crash on land.

At least four pyrotechnic destruct regions (see illustrations) on the boosters and external fuel tank could have been ignited by the leaking booster's flames, Shires said.

Shires believes the worst-case possibility involves igniting an explosive strip on the shuttle's huge external fuel tank. It was located near the flames that Presidential panel investigators think came from a suspected defective seal on the right solid rocket booster.

NASA investigators have focused on the O-rings that seal sections of the right booster rocket. Abnormally cold temperatures before launch could have made them brittle. That could account for the suspected leak.



Head-on view of shuttle rockets and orbiter shows positions of range-safety system components.

The NASA document shows a 20-foot-long charge of HMX explosive is positioned on the external tank directly between the right booster and the bottom of the orbiter. It also states the HMX destruct explosive is intended to split open the liquid-hydrogen fuel tank in the bottom of the external fuel tank assembly.

The technical reasoning behind splitting the hydrogen tank, the document says, is to disperse liquid hydrogen. Milliseconds after detonation, an explosive cord conducts the thermal charge to an 8-foot-long HMX linear-shaped charge (LSC) on the liquid-oxygen tank at the top of the external tank. All together, the fuel and oxidizer, the three main shuttle engines and the still-burning booster rockets could have made an explosive combination.

Vacuum Formed Behind Tank

NASA has said that just before the explosion the shuttle was hurtling aloft at Mach 3. That's three times the speed of sound at the altitude where it exploded, or about 2,000 miles per hour.

Shires told *EE Times* that he believes at that speed, a partial vacuum was created behind the big tank. The vacuum could have sucked heat from the booster's escaping flames to the HMX LSC a few yards away and touched it off.

Presidential panel investigator and Nobel laureate Richard Feynman, a physicist, has said it's unlikely that the external tank caused the explosion. Shires agrees, in that the explosion may not have begun in the tank. But he argues that the destruct-system explosives, mounted in an open trough on the insulated skin of the external tank, could have ignited the tank.

The flame plume appeared one-quarter of the way up from the bottom of the 150-foot-high right booster just across from the lower tank explosive charge. Another NASA technical document routinely mentions the flashpoint of pyrotechnic charges on the shuttle. But the manual presumes no other source of ignition is present besides the RSS electronic igniters.

Close to and above the so-called leaky seal, where the booster produced its most visible flame, a set of HMX explosives is emplaced as a linear-shaped charge. This LSC is located within the vertical wiring tunnel on the outside edge of the solid rocket booster. It's one of six 160-inch-long HMX charges. The HMX is supposed to be fired electrically at both ends, giving redundant detonation.

Any verification of the LSC exploding will have to wait until recovery ships bring up major segments of the right booster from the sea floor.

Close to and below the suspect booster joint, three mounting struts attach the booster assembly to the external tank. These struts contain NHX, another explosive compound which ignites at about 1,000°F. The strut explosives are ignited electrically to separate the boosters from the main tank at two minutes and six seconds into the mission.

The suspected leaking booster flames also could have ignited the NHX inside the strut. That would support the Presidential panel's hypothesis that the lower mount detached and the booster swiveled into the top of the external tank and destroyed it.

The NASA documentation also shows still another explosive charge resides on each rocket booster nozzle. It's called RDX and is designed to be triggered electronically after the boosters separate from the shuttle orbiter and main tank.

The boosters' steel nozzles are heavy. If the nozzles aren't blown away, they could plunge the boosters into the ocean. So they are severed to trim weight before the boosters' parachutes open and bring the boosters safely down to float and be recovered.

The flames from the suspected defective booster seal could have triggered these other explosives thermally, Shires added. A nozzle separated while the booster was still burning could have slammed into the orbiter or its engines and triggered an explosion.

Shires said that he hopes the explosive destruct systems will be reviewed during any re-engineering this year.

The Range Safety System

Why It's There, And How It Operates

Since rocketry's earliest days at Cape Canaveral, the Air Force has maintained authority over range safety for all launches. The role of the range safety officer is to prevent rocket systems from hitting populated areas.

To enforce the Air Force mandate on this, all rockets carry what are called Range Safety Command Destruct Systems (RSS). They're the destruct systems designed to blow up an errant vehicle.

Most components used on the space shuttle are proven subsystems that date back 25 years to the Mercury, Gemini and Apollo missions. But their use is vastly different in the shuttle program. The shuttle is the first manned system that uses several rockets firing at the same time. Thermally vulnerable explosive charges sit right next to the flaming rockets.

Normally, the shuttle's many pyrotechnic systems are fired electronically.

The components that relay radio and shuttle-signal commands to the pyrotechnics are called NSI systems, for NASA Standard Initiators. They control the discharge of a 1-µF capacitor into a high-temperature spark that ignites the explosives.

The shuttle carries nearly 1,000 pounds of HMX explosives. HMX is far more volatile than most aerospace pyrotechnic material. It has enormous raw explosive power. Pyrotechnics engineers rate HMX, pound for pound, among the most explosive materials on earth.

The trade-off for that power is HMX's relatively low ignition point. NASA documents show that HMX can be ignited thermally at temperatures as low as 350°F—that's lower than the temperature at which paper burns (about 450°F). Other pyrotechnics systems ignite at temperatures ranging from 400° to 1,000°F.

On the space shuttle, specially configured packages of pyrotechnic systems are called Linear Shaped Charges (LSCs). Lightweight, short LSCs are installed manually. Longer LSCs are put in place with cranes.

Val Shires, former test engineer on destruct system electronics, says that while he was testing destruct-system electronics, rumors swept the spaceport of at least one accident with HMX linear-shaped charges (LSCs). It supposedly happened inside the huge Vehicle Assembly Building (VAB) at Kennedy Space Center. Allegedly, static electricity set it off.

NASA documents further state that many LSCs are not designed for operation or storage below 20°F. Shires says routine installation practice calls for loading LSCs manually and by crane just before the spacecraft leaves the VAB for the launch pad. Normally, that happens a few days before flight. The doomed Challenger endured launch delays. It was exposed to severe winter storms at the Kennedy Space Center for many weeks before liftoff.

Normally, static grounds are attached to the 3-mil-thick copper and aluminum shields used to protect the explosives from static or RF-energy-induced detonation.

NASA engineer Tom Mullin and Tom Gracom, a range safety engineer for Lockheed's Kennedy Space Center facility, said that both booster rockets' destruct systems operated properly after the explosion. However, Shires has suspicions about the destruct system on the main external fuel tank.

NASA Exec Says Space Station 'On Track' And Will Stay Nuke-Free

By Richard Doherty

DETROIT — The space-station project is "on track," said NASA executive Peggy L. Evanich.

She told aerospace engineers and students the three-year planning period for the space station is twice as long as that for other space projects.

"We figure we can save more money in the long run that way," she said. Evanich spoke at the Society of Automotive Engineers Congress last month. SAE includes many aerospace engineers as members.

Evanich is member of NASA's space-station planning office in Washington.

She said the U.S. project is unlike the Soviet space-station project. She described the Soviet effort as a series of slightly evolutionary steps over the 15-year-old U.S. Skylab.

The U.S. space station, she said, will be the first orbiting platform to address directly the needs of manufacturing and earth observation.

Evanich predicted technological spinoffs from the space station will be greater than those from earlier NASA programs. Construction should cost $8 billion in public funds. But, she expects private and industry investment in the station's expansion will raise the total investment to $14 billion by 2000.

Evanich dispelled any notion that the space station would be a vehicle for nuclear-powered elements of President Reagan's Strategic Defense Initiative. She cited Section 106 of the 1965 NASA Space Station Act. The law mandates that the station can neither harbor, nor convey, nuclear weapons systems, such as those needed for nuclear-powered excimer laser systems, a key part of SDI. An excimer laser is a high-energy, short-wavelength laser that's powered by a nuclear device. Theoretically, its beam of light can destroy rocket weapons many miles away.

She outlined an opportunity that may lead to possible change in the NASA strategy for using unmanned, remote-controlled space robots. These are orbital maneuvering vehicles. She hopes that private industry will build and lease them to NASA for station construction and operation. That would be a vast change in NASA's past policy toward contractors. The Presidential panel on the shuttle disaster is reviewing existing policy.

Evanich said two companion unmanned stations would be required. One would survey from a polar orbit. The other would be a co-orbiting system.

She said the station will offer manufacturers a "microgravity" ratio less than 10^{-5} of earth's. That will answer many industrial needs for zero gravity for specialized manufacturing processes.

Evanich said the group will publish final space-station guidelines soon. Final design might take another year. If all goes well, the station could be operating within 10 years—a few years beyond Reagan's schedule.

She said so far, the shuttle disaster is not affecting the space-station program. But she cautioned that if another space orbiter is not made available, the present station construction plan could change.

Evanich explained that the space station will incorporate a closed system for life support. That means every drop of water would be recycled after treatment.

The present station configuration calls for life-support systems for a crew of four or six. They will have the same atmospheric pressure as earth (14.7 psi), not to accommodate the crew, but because industrial experiments need it.

"Our shuttle experience shows that just too many things go awry when climatic pressures have to be changed for industrial experiment packages," said Evanich.

She said all the cooperating nations—Canada, United Kingdom and the European Space Agency community—have shown industrial interest in the space station.

"All but Japan," she said. Evanich is surprised that Japan, of all nations, hasn't identified an industrial use for space—at least, not to NASA.

Evanich said European Space Agency members are key supporters of the space-station design effort. Station operation will depend heavily on experience gained with the ESA-designed SpaceLab system. That manned scientific module has already flown aboard the shuttle and was staffed by an international crew of mission specialists.

Evanich is more worried about cuts the Gramm-Rudman law mandates than by arguments that President Reagan's SDI program might cut into space-station funds. She countered audience questions, hinting that the station might benefit from SDI funding.

Delays Hold Up Gathering Data From Shuttle

Cleanup Required

CAPE CANAVERAL, Fla. — The final milliseconds of data from the destroyed shuttle are still to be gathered from on-board computers and recorders recovered from the sea off Cape Canaveral, Fla. They may offer clues to what went wrong.

Magnetic-core and plated-wire memories on the computers may have captured the data—after the shuttle explosion pulled the plug on radio telemetry transmissions to ground stations.

Four computers and tapes from at least three recorders are being treated to remove effects of immersion in salt water. The computers and tapes are being flushed and rinsed with deionized water. The tapes also will be oven-dried before data recovery begins. The tapes will be sent to Johnson Space Center (Houston) and copied. Then an analysis will be made of the mission data profile.

The process will take many weeks. That means the data will not be included in a presidential investigating panel report that's due April 18.

Another possibility for data recovery lies in four on-board CRT computers and displays. Three are in the flight deck. The fourth is aft. Each display has 8 kbytes of core memory. If IBM can recreate the last displays, that also could help the investigation. IBM says it will take several weeks to power-up the memories.

Each of three main booster engines on Challenger—the orbiter—carries two computers. One is the primary system; the other, a backup. Each had 16k of plated-wire memory made by Honeywell Inc.'s Avionics Division. Data in them may not have been relayed to recorders or ground stations.

Just before the explosion, the three orbiter engines were in trouble, said Wayne Littles, associate director of engineering at NASA's Marshall Space Flight Center (Huntsville, Ala.). One engine cut out milliseconds before the explosion cut off telemetry.

Littles said that just before the explosion engines were operating at 104 percent of their rated capacity. The extra four percent represents an improvement in power of Challenger's engines over the original ones that flew in the space shuttle Columbia.

It is not known if the twin flight deck CRTs have been recovered. Most of the cabin has been pulled from the sea. The suspected right solid rocket booster fell farthest from the Cape. Weather off the Cape is bad and seas have been rough, slowing recovery.

—Richard Doherty

NASA To Restore 3,000 Sensors To Shuttle

By Richard Doherty

HOUSTON — The 3,000 sensors that were shucked off the shuttles to save weight are going back on board before the spacecraft fly again.

NASA intends to resume "cautious" flights next year under strict new rules, guided by added data from restored systems.

The shuttle program's new boss, Vice Adm. Richard Truly, gave out that word to space-agency employees last week.

Three thousand extra measurements had been made aboard the first shuttle during "developmental" flights five years ago (see *EE Times*, Feb. 10, Page 1). But sensors were taken off when the spacecraft went "operational" three years ago. They were not on the doomed Jan. 28 Challenger flight.

NASA engineers at the Kennedy Space Center in Florida told *EE Times* last week that since 1983 the number of parameters being measured had shrunk to 4,000.

NASA officials said nothing about whether the added sensors that will be emplaced are the same as those on what NASA calls "heavy" developmental flights. "Heavy flights" mean extra weight aboard from sensors, cables and recorders that gathered developmental data.

Thomas Moser, NASA's associate administrator of space flight, said, "The first 12 months, we have laid out a manifest of what we think we'll do," Moser said. "Once we see what modifications we have, what flight information we have to get back from the vehicle, then we'll be ready for the second flight."

Some engineers have told *EE Times* that more sensors might have detected flaws that caused a suspected leak in the seal on the right solid booster O-ring section joint. Escaping flames are believed to have triggered the worst U.S. space disaster, the first during a flight.

EE Times learned last week that while the solid rocket boosters carried their own computers, they did not monitor the suspected seal. That may be added to NASA's list for fixing when the boosters are redesigned.

One engineer, Val Shires, told *EE Times* he believes escaping flames could have ignited explosives in the shuttle's on-board self-destruct system that blew up the spacecraft (see *EE Times*, March 24, Page 1). Shires had been an electronics test engineer for the shuttle's pyrotechnics.

Added sensors, one NASA engineer said, would not be the top priority toward understanding shuttle launch and flight dynamics. NASA engineers would like more realtime analysis of the operation.

During Challenger's launch, mission-control engineers saw less than 1 percent of flight data on their computer screens. The only trouble indications were that the main engines on the orbiter were gimballing to correct for an unknown force.

Truly, a former astronaut, did not say there would be improved on-board data analysis for next year's flights. Instead, a computerized analysis system could monitor data passing through consoles and monitors at Houston and Kennedy space centers.

Truly made other points about resumed shuttle flights. Among them:

- Shuttle launches. They'll occur only in daylight and during warm weather. The schedule calls for nine launches in 1987, 14 in 1988 and 18 in 1989. The Challenger took off Jan. 28 after it had stood on Launch Pad 39-B for weeks, and after a night of very low temperatures at Cape Canaveral. The severe cold is suspected of making the O-ring rocket booster seal brittle and allowing 6,000°F flames to leak.

Marshall engineers stick to their hypothesis that the leaky right booster seal precipitated the disaster. But the boosters' on-board computers and recorders did not detect any trouble. NASA executives knew for three years the seals were troublesome. But because the seals had backups, the agency never made them a Criticality 1 concern—meaning the vehicle and crew could be lost if they went haywire.

(Continued on Page 13)

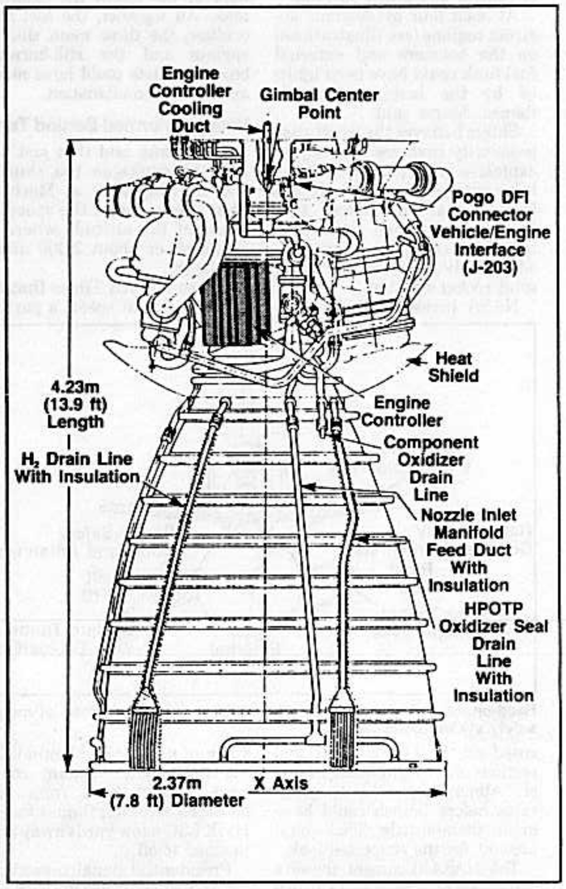
(Continued from Page 12)

- Booster redesign. It will be done by Marshall Space Center engineers in Huntsville, Ala. Tests are under way to find if the field joint seals can be re-engineered. Or whether a single casing for one-time use could do the job.
- Fault analysis. This will be reviewed to find better ways to identify hundreds of critical shuttle parts that may be defective.
- Landings. Shuttles will land at Edwards Air Force Base in California's Mojave desert. That's in response to chief astronaut John Young, a veteran shuttle commander. He rapped the Cape Kennedy landings. Young griped that the Canaveral landings are hazardous because the runway is too narrow and the weather changes too much. Young says NASA complained that Edwards landings meant the orbiters have to be hauled back atop 747 jumbo jets from California so they can be refitted for the next flight. That added delays.
- Decision policy. NASA will investigate the decision process that requires contractors to justify safety arguments against making launches, rather than NASA heeding their cautionary warnings.
- Payloads. Military cargoes get first priority when flights resume. Commercial satellites and scientific probes will play second fiddle to military needs.
- Crew. Only veteran astronauts will fly on the next mission. Truly said NASA still intends to fly civilians but couldn't say when.
- Escape systems. Truly said it's doubtful that crew escape methods will be re-engineered, unless the presidential panel insists.

Truly said that this NASA "conservative, safe approach isn't going to be a namby-pamby space program."

Nor, he added, would it impede the nation's space program.

"The business of flying in space," he added, "is a bold business."


Engine Controller Cooling Duct
Gimbal Center Point
Pogo DFI Connector Vehicle/Engine Interface (J-203)
Heat Shield
4.23m (13.9 ft) Length
Engine Controller
Component Oxidizer Drain Line
H_2 Drain Line With Insulation
Nozzle Inlet Manifold Feed Duct With Insulation
HPOTP Oxidizer Seal Drain Line With Insulation
2.37m (7.8 ft) Diameter
X Axis

Each of the orbiter's three main engines on the shuttle feature twin computer controllers (see shading). Each controller has 16 kbytes of plated-wire memory. The plated wire memories are made by the Honeywell Inc. Avionics Division.

More Shuttle Fallout: Layoffs At Aerospace Companies

By Matthew J. Doherty

Hundreds of aerospace employees in Florida are being laid off in the wake of the shuttle disaster.

Lockheed Space Operations Co., the primary shuttle processing contractor, terminated 263 employees effective March 14 and will lay off another 367 workers employed at the Kennedy Space Center May 2.

"The cuts were across the board," said Stuart Shadbolt, a Lockheed spokesman, adding that employees "from helpers to engineers" were let go.

More than half the layoffs, some 330 jobs, were directly linked to the loss of the Challenger, Shadbolt acknowledged.

He said the remainder were not related to the accident, which claimed the lives of all seven crew on Jan. 28 and is now causing economic fallout.

Shadbolt said the other employees were involved in NASA projects that had already been completed, such as launch pad renovations and modifications on Challenger and Atlantis.

Other companies involved in shuttle processing contracts are planning layoffs as well.

Shadbolt said he heard that Grumman Corp., Morton Thiokol, and Pan Am will ax employees in May.

A Grumman spokesperson, Miriam Reid, confirmed that the company's Technical Services Division in Titusville, Fla., will terminate 70 employees May 2. The affected personnel, mostly computer operators and technicians working at the Kennedy Space Center, were notified last month, she said.

No engineers are being let go, Reid said. Grumman employs roughly 800 employees at the Kennedy Space Center and 300 at Vandenberg Air Force Base.

A Morton Thiokol spokesperson said he had heard there might be layoffs, but he could not confirm that. Pan Am could not be reached for comment. Other NASA contractors announcing layoffs in the Space Coast area this month included Boeing Aerospace (about 85 employees), and Planning Research Corp. (150 employees).

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Challenger Computers, Data Recorders May Hold Clues

By Richard Doherty

CAPE CANAVERAL, Fla. — On-board spacecraft tape recorders and computers, recovered from the sea off the Florida coast last week, may turn up significant clues in the space shuttle disaster. They were recording right up to the final milliseconds of the shuttle's life.

"There are data only the computers see," NASA engineer Bill Glaser told *EE Times* last week. He hopes the computers' core memories will turn up database-mission profile records of Challenger's last moments. Five IBM-designed redundant computers were on board.

Recovery ships have pulled three of four recorders from the avionics bay of the sunken Challenger orbiter crew compartment. Four of the five computers were raised at the same time and are at IBM Corp.'s Federal Systems Division plant in Owego, N.Y.

An IBM spokesman at the Owego facility, where the computers are made, said IBM will conduct the electronic probing of the computers. The computers store 106 kwords × 32 bits of data. Whether or not the data can be retrieved depends on the amount of corrosion. The procedure is to store the computers in salt water until they can be flushed with de-ionized water. Then they will be powered up in an attempt to recover data. NASA will observe the testing.

Glaser told *EE Times* last week the computers monitor data not monitored with radio telemetry or onboard tape recorders. He said most of this data is transitory. But, possibly, the IBM computers might have caught a "data snapshot" that could help engineers analyze the flight.

Odetics' Recorders

Normally, the shuttle is equipped with four reel-to-reel-tape data recorders made by Odetics Inc. (Anaheim, Calif.). The company also provided recorders used to store developmental sensor data from the first series of shuttle launches in 1981-82 (see *EE Times*, Feb. 10, Page 1).

NASA has ordered its spokespeople not to talk directly about the disaster. However, engineers at NASA's Kennedy Space Center talked with *EE Times* about recorder and computer performance throughout the shuttle program.

Two recorders known as OPS (operational recorder systems) are 14-track tape transports. Together, they monitor data flow at 4,000 measurements per second. One records at 60 kbits per second; the other at 128 kbps. These recorders monitor main engines, flight instrumentation and, if the channel was switched on, cockpit communications among the crew.

A separate payload recorder monitors subsystems and sensors aboard satellites, laboratories and experimental bays lofted into space. Switched on depending on the style of payload and mission requirements, it captures data at 64 kbps.

The MADS System

The last recorder is the Modular Auxiliary Data System recorder, or MADS. It is a 24-track system used to record either analog or digital data using wideband FM design.

Glaser said the MADS typically collects data used for ongoing monitoring of the shuttle and its subsystems' performances. Typically, MADS monitors mission trajectories, accelerometer inputs, temperatures and stress on the orbiter and assembled vehicle. These data are not monitored by any other on-board system nor are they radioed to mission control. After a flight, NASA copies the tapes and sends them to appropriate contractors for on-going analysis.

Normally, these recorders "mirror" all data sent to the radio telemetry system. However, Glaser said there is a chance that they may have captured some data from orbiter sensors and from the attached boosters and tank after the radio telemetry link was cut.

Seaworthy Systems

NASA engineer Dick Dennis is optimistic that the recorders will provide useful data even though they've been soaking in the sea for six weeks. He bases his view on experience with similar Odetics recorders used in earlier shuttle developmental flights. The recorders stored data from the heavily instrumented solid rocket boosters that landed in the sea.

Dennis said these earlier, heavily instrumented shuttle missions used the Developmental Flight Instrumentation System. Dennis reckons that 3,000 additional measurements were made on the first four "developmental" shuttle flights.

After the fourth flight, NASA decided to move the shuttle into its "operational" phase. Yet, engineers who had worked on the shuttle during that period think that action was premature. Their arguments and suggestions for getting the program back on track will be explored in future issues of *EE Times*.

Parallel Timing Clues

Investigators may find vital clues after the parallel data from the tape recorders and core memories are time-aligned and analyzed.

For example, if data from the right solid rocket booster disappeared just before data from all sensors stopped, that could support the hypothesis that the right booster swiveled away from the external tank and pivoted into the tank's top.

If gas pressure in either the liquid hydrogen or oxygen tanks fell in a specific sequence, it could help investigators deduce if the shuttle's tank ruptured or exploded.

Glaser does not know whether the MADS recorder data are available to investigators. MADS is controlled by ground operators. "The boys from JSC [Johnson Space Center in Houston] control it when it runs." That's because the JSC in Houston takes over flight responsibility after the spacecraft clears the launch tower.

If MADS was turned on, it might provide added clues to stress and motion from sensors inside payloads in the cargo bay.

Glaser said the Odetics recorders generally have been reliable. "Once in a while, we would lose a data track or two."

The design of the OPS recorders allows one unit to record flight data, while the other downloads data to tracking stations on earth. They routinely switch tasks during shuttle flights.

During the doomed 51-L mission, engineers Glaser and Dennis said, both recorders were on. As on most previous missions, this was done as a back-up to radio telemetry. The two tapes are played back after the Challenger shuttle reaches orbit. That's to compensate for radio gaps that might have interfered in telemetry reception.

Europe Plans To Become Major Space Power By 2000

By Roger Woolnough

LONDON — Europe is starting to put in place several programs that could make it a major space power by the end of the century.

Much still has to be decided, not the least of which is where money will come from and exactly what it will be spent on. But there is a new sense of urgency about agreeing on future projects, not only from space professionals, but also among the politicians.

Projects into which European countries have already put small amounts of money for feasibility studies include:

- Hermes, a French-backed plan to build a reusable spacecraft which would be launched by the new heavy-duty Ariane-V rocket. It would lift 4.5 tons of freight and a crew of two to six people into orbit.
- Hotol, a horizontal takeoff and landing spaceplane with a revolutionary propulsion system, conceived by British Aerospace plc and Rolls-Royce plc. It could launch a 7-ton payload at about one-fifth current costs, placing a satellite into equatorial orbit and returning directly to Europe.
- Columbus, a manned space-station project led by West Germany and Italy with support from the European Space Agency. Although it would be a plug-in module to the U.S. space station, the Europeans want Columbus to have its own propulsion system, so it could operate autonomously.

Clearly, things are changing.

Things Are Changing

In the early days of space exploration, Europe had little option but to hitch a ride on U.S. launchers.

Now, there is a feeling that this relationship has gone about as far as it can. Europe's ambitions have been increasingly evident from the projects undertaken in association with the U.S. National Aeronautics & Space Administration (NASA).

Spacelab, a European-developed space laboratory, has flown in the space shuttle both as a manned research module and as an observatory. Next in line for shuttle launch is Eureca, a European retrievable carrier to which the European Space Agency (ESA) has already committed $97 million. If the original timetable holds, Eureca will be launched by shuttle as a free-flying satellite in March 1988, and recovered six months later, again by shuttle.

But the success of the Ariane launcher, which now has orders worth $1.2 billion to place 29 satellites in orbit over the next few years, has given European nations confidence that the time is

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It's Ground Zero For Private Rocketeers

NASA Now More Cooperative, But Entrepreneurs Run Into Static

By Richard Doherty

NEW YORK — Private American rocketeers won't find it easy to get into space quickly despite NASA's intent to shift policy on private-launch entrepreneurs.

"We're not getting much co-operation," said former astronaut Donald "Deke" Slayton.

Slayton heads Satellite Transportation Systems of Texas, a private space enterprise. It's the most notable American company trying to launch into space.

He said NASA's policies have hamstrung STS and others. Because of the strictures, STS has been forced to buy used key rocket components from space junkyards.

"We're doing the best we can," Slayton said, "to make use of hand-me-down equipment from the scrap heap."

Funding is hard, too, Slayton added. He can't figure out where the choke points on private space initiatives are. And he's having trouble getting a suitable launch site.

For the past five years, critics say, NASA has wet-blanketed private U.S. companies when they tried getting into space business.

Shifting Course

But after the Challenger blew up on Jan. 28 and knocked the shuttle program off kilter, NASA has said it's shifting course to let private firms hoist routine satellites and probes into space. These could be the more profitable payloads.

NASA concedes it will be several years before STS or other private rocket companies can launch. And they'd still have to use NASA or other government launchpads.

Still, in 1984 STS got a demo launch off from the West Texas desert. But most subsystems it used in its ballistics tests were old.

STS had to scavenge among decades-old, abandoned surface-to-air missile and ICBM program hardware to put together a launch vehicle. NASA documents show that it also has cannibalized shuttle orbiters for parts to get others ready to fly.

All parties generally agree that nothing much is likely to happen for at least two years—either with American companies or foreign competitors.

Some fear the French Ariane program could siphon a little of the business that NASA would lose since the shuttle disaster. But the French space program is booked solidly. It just doesn't have extra capacity.

Last Thursday, the Ariane rocket countdown to launch was halted 0.16 second before blastoff from its base in Mourou, French Guiana in South America. The Ariane was carrying a payload of two satellites. One was from a United States customer.

The Russians won't be ready to truck commercial payloads into orbit for a while, either. They're two years from even testing their reusable space shuttle. But once they get off the ground, they conceivably could grab off some Western space trucking jobs.

NASA hopes to resume shuttle launches next February. It also has planned a dozen missions carrying mostly military cargos for 1987. In a few weeks, reports should come in from other NASA branches on military and industrial options to use space in the next generation.

A fleet of four operation shuttle vehicles was needed for such programs. With Challenger gone, only three are left. The foursome was critical to building a space station in the early 1990s. But that may not happen for another 10 years.

Ironically, two weeks ago the Soviets openly launched a two-man crew into earth orbit to begin operation of what Western experts believe is a space station. The blast-off was broadcast live on Soviet television and fed worldwide to other TV networks.

Pressure From Congress

Meantime, there's other heat on NASA—from Congress. Sen. Ernest F. Hollings, D-S.C., wants NASA to justify spending any more money fixing up an aging shuttle design. It dates from the 1970s.

NASA's acting administrator William Graham told Congress $3 billion is needed to replace Challenger. That includes $315 million to redesign the solid-fuel rocket booster field joints suspected of touching off the explosion. It will take between one to two years to build. And key parts of the orbiter—tail and wings—would be the spares Rockwell International built for replacements.

European Nations Line Up Their Ducks To Make Major Thrust In Space By 2000

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coming when they must go it alone with manned space flight, too.

Officially, Ariane has been a project of the 11-nation ESA. It has now been handed over for commercial exploitation to Arianespace, a company backed by several European banks and aerospace companies.

But it is no secret that the concept would hardly have got past the back-of-an-envelope phase without French enthusiasm and, especially, French money.

French institutions are the main investors in Arianespace, too. Now France is urging Europe to collaborate on Hermes. It has already said it will pick up 50 percent of the $1.7 billion cost itself, but would like at least 10 other European countries to take part.

So far, only West Germany has shown much interest. The West German government has said it would take a 30 percent stake, but it would like the launch to be postponed two years to 1997. Nonetheless, something like Hermes follows naturally from Ariane-V, which already has full European backing and is expected to be ready by 1995.

There is little point in building a heavy-duty launching capability without having something to launch. If the French continue as Europe's most visible space promoters, Britain has started to act with the enthusiasm of a convert.

Britain Eager To Go

For the first time, it has abandoned its tradition of spreading responsibilities for space among different government departments, and created a single authority in the form of the British National Space Center.

"What changed the government thinking was that nowadays, particularly with the space station round the corner, all programs are going to be related one to another," said Roy Gibson, the former head of the ESA, who has been picked as the center's first director-general. Even though the center does not yet have a budget, the government has allowed it to earmark about $4.3 million for initial studies of the Hotol spaceplane, which British Aerospace and Rolls-Royce have been touting discretely for the past two years.

"Many of the uses we might make of space are ruled out at present by our not having routine and cheap access to space," said Industry Minister Geoffrey Pattie. On paper, Hotol looks as though it could make high launching costs a thing of the past.

It is based on a new propulsion system called Swallow, proposed by Rolls-Royce. This reduces the need for Hotol to carry large quantities of liquid fuel by using a hybrid engine which combines air-breathing and rocket propulsion. To carry a payload of 7 to 11 tons into low earth orbit, Hotol would use a liquid-hydrogen fuel air-breathing engine during the early stages of flight and then draw on liquid oxygen.

It would take off from a standard runway, but airframe weight would be reduced by launching it from a reusable trolley which stays on the ground.

On return to earth, with most of the fuel used, Hotol's landing weight would be supported by the relatively low-cost built-in undercarriage. At first, Hotol is seen as an unmanned automatic vehicle, but it could be adapted for manned operations at a later date.

It has been suggested it could carry passengers from Europe to Australia in one hour—a "Down Under Express," rather than an "Orient Express."

Even if the concept is proved, the main snag in developing Hotol will be funding it. It would cost at least $725 million, which is far more than Britain alone is likely to find.

"We will never have the money to do it ourselves," admitted Gibson of the British National Space Center.

Comments Pattie: "If Hotol is confirmed to be a technically and economically viable project, it will need to be considered alongside other long-term European plans."

The British government argues that in its characteristics and timescale, Hotol is likely to be complementary to Ariane-V and Hermes.

But persuading the rest of Europe of that may be more difficult than building the spaceplane itself.

Columbus Dogged

Disagreements dog Columbus as well, but this time they are between Europe and the United States.

NASA's plans for a manned space station include contributions by Japan, Canada and Europe.

Only the ESA wants a unit which could detach itself from the NASA craft, and be enhanced over a time to become an autonomous European space station.

From about 1992 onwards, it would provide facilities for scientists and engineers to carry out research in zero gravity. Exemplifying Europe's determination to realize this is that contracts for definition studies have been placed already.

Britain's Logica plc received four contracts from Aeritalia of Italy, Matra S.A. of France and British Aerospace.

These include defining human factors and software requirements in the manned laboratory, undertaking design work for the data-management system and studying operations and ground support facilities for the man-tended platform. Logica's contracts add up now to little more than $500,000.

If Europe is going to move into the big leagues in space, it has to commit itself to spending billions of dollars over the next decade. That can only be contemplated as a collaborative effort.

Speaking of his plans to win funds for the British National Space Center, Roy Gibson said: "We are going to give ministers a series of menus—the tourist menu, the business executive menu and the gourmet menu, depending on how much money is in the kitty at the time."

But when the local dishes of France, West Germany, Italy and other European nations are added, the meal may prove indigestible.

After many setbacks, Europe has achieved much in the way of collaborative ventures, but in space it is facing both its biggest opportunity and its biggest challenge.

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4 Aerospace Contractors Forecast Space Vehicle Needs

By Jim Van Nostrand

Separate studies by four aerospace contractors predict a need for new U.S. manned and unmanned shuttle-type, reusable space-launch vehicles to put an estimated 25 million pounds of payload into space by 2010.

Thereafter, they said, new airbreathing technologies could lead to single-stage earth-to-orbit aerospace planes. And full-scale deployment of a strategic, ballistic-missile defense system and major interplanetary missions—such as a manned trip to Mars—could create a need for a new, unmanned heavy-lift vehicle that can put 400,000-pound payloads into orbit.

Through the next quarter century, expendable rockets should serve as back-up launch vehicles, and the space program will require a variety of advanced upper-stage boosters and orbital-maneuvering and orbital-transfer vehicles, the contractors have concluded.

The Defense Department and the National Aeronautics and Space Administration ordered the studies. The National Security Council had asked for the studies to identify manned and unmanned systems needed to meet the requirements of all users in 1995 and beyond.

Preliminarily, one major goal, a tenfold cut in space-transportation operating costs, seems attainable, said Col. William Zersen, deputy commander for launch and control systems in the Air Force Systems Command. The target is a $200-to-$300-per-pound cost for putting payloads into low-earth orbit, said LeRoy Nichalston, the Martin Marietta study's director.

Zersen said an interim report to the Security Council in June should conclude that a two-stage, fully reusable vehicle would have lower technical risk than the space shuttle system.

The contractors are recommending an unmanned cargo vehicle by 1995 and a new shuttle by the year 2000.

An unmanned cargo launcher appears to make sense economically, and a new, manned vehicle of unspecified size will be needed near the turn of the century, Zersen added. Flexibility and greater assurance of access to space make systems with two types of launch vehicles attractive, he said.

He predicted manned flights into geosynchronous orbit by 2000 and forecast a "substantial need" for an orbit-maneuvering vehicle with a robotic front end that could undertake a variety of in-space tasks.

Boeing Aerospace Co., General Dynamics Corp., Martin Marietta Corp. and Rockwell International Corp. began their studies last September, long before the Challenger explosion and the failure of successive Titan 34-D and Delta launches. The work is to be finished in December 1987.

The contractors do not agree on every detail, but one planner, John Peller, a Rockwell vice president, said he was amazed by the commonality, which he estimated at 90 percent, among the four preliminary reports.

Among their highlights:

- The contractors believe that a new, unmanned, partially reusable cargo vehicle will be needed by 1995, and a new manned launch vehicle—a next-generation shuttle—is called for by 2000. They said a 400,000-pound, heavy-lift launcher would not be needed before 2010.

Estimates of needed lift capacity range from 125,000 to 200,000 pounds for the unmanned vehicle and 35,000 to 65,000 pounds for the manned system. The shuttle, which would be retired around 2000, has a payload capacity of 65,000 pounds.

- Each study is concentrating on mission requirements and cost issues before starting design work on new space vehicles.

"Vehicles will be last, not first, in design. There's a big payoff in keeping designers away for awhile," said William Rector III, a General Dynamics division vice president.

The analyses emphasize life-cycle costs, which engineers don't like to do, added Donald B. Jacobs, vice president of the space-transportation division at Boeing Aerospace.

The approach involves a bit of culture shock for engineers and the entire aerospace industry, said Peller.

- An order-of-magnitude cut in launch costs is feasible if the required technology is made available in a timely manner, if improvements are made in mission control by 1995 and upgraded thereafter and if the new launch vehicles incorporate improved logistic and operational features, Rector said.

'Vehicles will be last, not first, in design. There's a big payoff in keeping designers away for awhile." —William Rector III

Objectives at Boeing Aerospace include reducing the $1,661-per-pound cost of launching a shuttle payload to $270 a pound for unmanned cargo and $600 a pound aboard the manned space shuttle II, Jacobs said.

Artificial intelligence, 99 percent autonomous launch vehicles and mission standardization can cut mission control work on a manned flight from 178 man-years today to 42 after 2000 and, on an unmanned mission, from 85 to 55 man-years, Rector added. And logistics and operations requirements can be reduced from 350 to 45 man-years for a manned flight and from 80 to 40 man-years for an unmanned mission, he said.

The final reports will assess requirements for both high and low earth orbits, intra- and inter-orbit transportation needs, lunar and planetary projects and new airbreathing launch systems, said Paul Holloway, deputy director of NASA's Langley Research Center.

Development of a partially reusable cargo vehicle by 1995 would permit several years of flight testing of the new booster system before it would be used for manned flight in the next-generation shuttle, around 2000, said Martin Marietta's Nichalston.

"Reusable launch vehicles are cost winners unless there are few launches. At 25 launches per year, the costs of shuttle derivatives and fully reusable vehicles are not distinguishable. At 75 launches per year, fully reusables have a clear edge," Peller said.

INTERNATIONAL NEWS

Europeans Back Hermes Spaceplane

By Roger Woolnough

PARIS — Europe has adopted Hermes, the French manned spaceplane, in a step toward eventual launching of astronauts into space.

But the decision leaves Britain's spaceplane proposal, Hotol, with an uncertain future. Hermes is a delta-wing, manned spaceplane which will be launched into low earth orbit by the Ariane 5 rocket.

At the end of its mission, it will glide down to land on a runway.

The concept for the plane has been developed by the French space agency Centre National d'Etudes Spatiales (CNES). At the end of June, the Council of the 11-nation European Space Agency (ESA) adopted a resolution to go ahead with a preparatory program for Hermes.

Although the proposal won a wide majority among ESA members, the decision was clinched by backing from West Germany.

Previously, the West German government had been unwilling to decide on the project until next year. The ESA sees the approval of Hermes as a further step toward establishing an autonomous European infrastructure in space.

Hermes is closely related to the Columbus project, a manned space laboratory.

Although Columbus will form part of the U.S. space station, ESA officials have been pressing to give it a free-flying capability. Financing of the Hermes preparatory program has not yet been settled, but France is likely to contribute 50 percent of the cost.

It hopes that West Germany will chip in with a further 20 to 25 percent. Italy has said it will take a 13-percent stake and Belgium will contribute 7 percent.

The pro-Hermes vote at the ESA Council meeting puts Britain in a spot. It is still hoping to win support for Hotol, a horizontal takeoff and landing spaceplane which is a joint venture by British Aerospace plc and Rolls-Royce Ltd.

Like Hermes, Hotol would travel in a low earth orbit, and land normally at the end of a mission. But it would not need to be launched by rocket.

Instead, Hotol would take off from a standard runway under its own power.

A Small Stake

It is now likely to take a small stake in the Hermes program, if only for the sake of European unity. Once the finances and other details are agreed upon, the Hermes preparatory program is expected to start next fall, and run until June 1987.

This will prepare the way for the ESA member-states to decide in mid-1987 on a Hermes development program, aiming for first launch in 1995-96. As conceived at present, Hermes will have a length of 59 feet and a wingspan of 33 feet.

It will carry four to six crew members (including two pilots).

EDITORIAL

Steve Weitzner
Editor

Call It Sleep . . .

. . . What else can it be when the White House stands by its choice of James C. Fletcher as helmsman of the National Aeronautics and Space Administration? The wisdom of Fletcher's continued tenure at NASA is questionable at best after last week's disclosure in *The New York Times* of details about the selection of the Morton Thiokol segmented booster design. A flaw in that design caused the destruction of the shuttle Challenger and its crew.

Fletcher was the NASA administrator who chose the Thiokol design some 13 years ago for its economy. Then, a NASA booster evaluation panel rated it last on design—behind Lockheed Propulsion Co. and United Technology Center, which also proposed segmented designs, and the Aerojet Solid Propulsion Co., the sole "monolithic" proposal. The Thiokol proposal was lowest in cost. The question of economy's place in advanced technology program decisions is a subject for another editorial.

For now, suffice it to say that less than one year after Fletcher decided on Thiokol, the General Accounting Office audited the decision at the request of Lockheed and found that the initial cost advantage that won Thiokol the contract was the result of a costing error. Fletcher did not, in light of that new information, take GAO's suggestion to reconsider the use of technically superior designs. It is now too late to do anything about the tragic events that followed that decision.

Senator Albert Gore Jr. (D-Tenn.) has called for a congressional investigation to look into the original contract award. At issue:

- Fletcher's ties to a Utah business lobby when he joined the agency;
- The fact that two former Thiokol employees were among the six top officials of the NASA booster evaluation board—no other booster companies had former employees among the top six;
- The fact that NASA's Lewis Research Center, the world expert in large solid rockets, had no role in the evaluation, and that this work was directed instead to the Marshall Space Flight Center, which had virtually no such experience.

Fletcher has maintained that his decision was "squeaky clean," and no one has suggested that he made the decision for personal economic gain. But there have been allegations from members of Congress, former NASA employees, and industry that Fletcher showed bias and favoritism in awarding the contract to Utah-based Thiokol. Now, Fletcher has said he will seriously consider staying out of contract decisions regarding the boosters because suggestions of impropriety have been raised.

In our opinion, that's not good enough. Even if charges of bias and favoritism prove wrong, even if Fletcher's decision was "squeaky clean" and he can prove it, his credibility has been badly shaken by the documents detailing the selection process and his decision to stick with the Thiokol booster after its cost advantage was greatly reduced.

Facts that have come to light include the General Accounting Office's June 24, 1974, statement that NASA should weigh a reconsideration of the selection because mistakes had been made in fuel cost. Those mistakes made the first-ranked Lockheed design appear $122 million more costly than last-ranked Thiokol. The readjustment made the difference between the best design and the worst $54 million. Nevertheless, on June 27, 1974, Fletcher upheld his selection, saying his initial rationale remained valid, even assuming the GAO's position on the costing error. The rationale: that the main criticism of the lower-cost Thiokol design's mission suitability were "technical in nature, were readily correctable and the cost to correct did not negate the sizable Thiokol cost advantage."

"Readily correctable?" In August 1973, Aerojet, the contract competitor which proposed a monolithic design for the solid rocket, said the advantage of segmented designs was "solely to satisfy facility location and transportation constraints at the ultimate compromise of crew safety. . . . Acceptance of the integrity of the O-ring [used to seal the segments of Thiokol's design] is largely a matter of faith." The document further noted that 99.9 percent of the nation's solid rocket boosters were monolithic designs.

Of course, Fletcher could not foresee the failure of the O-ring. Nor should he have been expected to make the technical decision between the two approaches. After all, the evaluation board placed two segmented designs ahead of Aerojet's monolithic design. But Fletcher faces some tough questions about why the Lewis Research Center was not consulted in the decision, about the makeup of the evaluation panel and about his decision not to review Thiokol's selection. And his role in the selection of the booster that tragically derailed the whole program carries emotional weight that cannot be ignored.

For the sake of NASA's 21,000 employees, for the sake of the next space crew, for the sake of waves of astronauts that will eventually be needed to man the space effort and for the sake of national confidence, it is time the White House asked Mr. Fletcher to step down as the head of NASA.

Steve Weitzner

NASA Reshuffles Science Missions In Challenger Aftermath

By Jim Van Nostrand

WASHINGTON — The Hubble Space Telescope tops the list of scientific missions awaiting new launch dates on the revised space shuttle manifest that U.S. space officials plan to make public soon.

The National Aeronautics and Space Administration (NASA) hopes that the $1 billion orbiting telescope will escape the current grounding of the shuttle fleet with a delay of not much more than two years.

But the space agency is less optimistic about prospects for launching other major space science vehicles, including the Ulysses mission to the sun, the Galileo probe of Jupiter and the Magellan flight to Venus.

The U.S. solar system exploration effort has been set back 15 years by a combination of shutting down the shuttle program and abandoning development of the Centaur booster, which was to have been used to lift large shuttle-launched payloads beyond low earth orbit, said Geoffrey Briggs of NASA headquarters.

The new shuttle manifest could be released within a week, said a NASA news officer. He said shuttle flights should resume in the spring of 1988. The Hubble launch, which was slated for last May prior to the Challenger accident, is expected to go off in 1988.

Ulysses, which was also scheduled for a May launch, will probably not get into space before September 1989, said a report by the project's NASA manager, Willis Meeks, and its European Space Agency (ESA) manager, Derek Eaton.

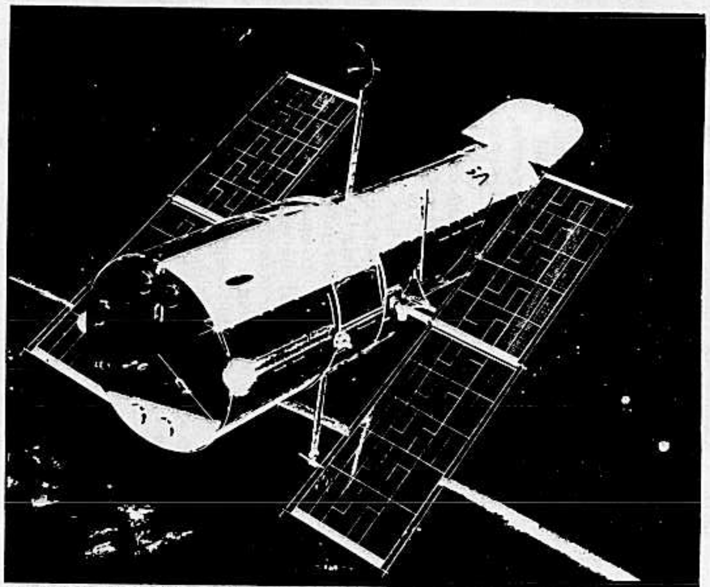
Galileo's launch date could slip as far as May 1990, said John Casani, project manager at the Jet Propulsion Laboratory.

And Magellan, which was awaiting an April 1988 launch, will probably remain earthbound past 1990, said Charles Brown of Martin Marietta Denver Aerospace.

A Centaur upper stage was to have been used for each of the three solar system probes. But Centaur was canceled because of the risks involved in launching a fueled rocket system aboard a manned shuttle.

The Hubble Project

The Hubble telescope will be equipped with a 2.4-meter primary mirror and five camera, spectrograph and photometer instruments. It is expected to expand the terrestrial-telescope equivalent resolution of the universe by a factor of seven, or a volumetric factor of 350, said a paper by NASA's James Odom and Royce Mitchell.



The Hubble Space Telescope is equipped with a 2.4-meter primary mirror and five camera, spectrograph and photometer instruments. It is likely to be launched in 1988.

Source: Lockheed

The facility will be free-flying and remotely controlled for a projected 15 to 20 years of operation. It will receive substantial on-orbit maintenance, upgrading of scientific instruments and periodic reboosting to offset orbital decay.

ESA Involved

ESA is supplying solar arrays and one scientific instrument, and ESA-designated scientists will get a fraction of the telescope's viewing time.

Commands and data will be handled through the Tracking and Data Relay Satellite and DOMSAT communications satellites.

During a five-year mission, Ulysses is expected to pass over the solar pole and spend at least 150 days above 70 degrees latitude before entering a second solar latitude phase over the sun's opposite hemisphere.

Ulysses' primary objectives are to investigate, for the first time, as functions of solar latitude, the properties of the solar corona, the solar wind, the heliospheric magnetic field, solar and nonsolar cosmic rays, solar radio bursts and plasma waves and the interstellar/interplanetary neutral gas and dust.

It will also check out Jupiter as it flies by on its way to the sun. It will measure the Jovian magnetosphere and the direction of cosmic gamma-ray bursts and search for gravitational waves.

Near continuous data throughout the mission is a prime scientific requirement, the project report said. Data will be stored on board during gaps in ground-station coverage and replayed, along with real-time data, during periods of coverage (nominally eight out of every 24 hours) by NASA's Deep Space Network.

Ulysses will get electricity from an on-board radioisotope thermoelectric generator. It would have been the first payload with a significant nuclear source on a manned shuttle flight.

The spacecraft was supplied by ESA after the United States dropped plans, due to budget constraints, to build a counterpart for a dual spacecraft mission. Both space agencies supplied instruments for the scientific payload.

Galileo

Galileo is designed to make the first direct sampling of Jupiter's atmosphere, examine the chemical composition and physical state of the planet's moons and investigate the structure and physical dynamics of the Jovian magnetosphere.

Original plans for a direct trajectory flight will probably be replaced with an earth-gravity assist trajectory, Casani said.

A probe will separate from the spacecraft about 150 days before its arrival at Jupiter, enter the planet's atmosphere and descend by parachute. The probe is expected to transmit atmospheric data for about 60 minutes before temperature and pressure destroy it.

22-Month Orbit

The main spacecraft will fly within 1,000 km of the moon Io for scientific observations before beginning 22 months of orbiting Jupiter. Between five and 10 complete orbits can be made, and each will include a close encounter with at least one of the planet's moons, Casani said. The spacecraft will also be able to conduct in-depth exploration of Jupiter's magnetosphere.

Casani said launch options for Galileo include the shuttle and a two-stage inertial upper-stage booster, which would require redesign of on-board booster systems; the shuttle and a yet-to-be-developed twin-stage inertial upper-stage booster, and a new Titan IV/Centaur expendable rocket system, which is expected to be available by early 1991.

Magellan will use radar to generate digital images that will provide a map of more than 70 percent of the surface of Venus—the last planet in the solar system to be mapped. Resolution will be equivalent to the first mapping of Mars by Mariner 9. The spacecraft will also make gravity and altimeter measurements.

The mapping will last about 250 days, during which time Venus will make one complete rotation. The spacecraft will be required to point its high-gain radar antenna toward the planet and follow a predetermined ground track during each mapping orbit and then point the antenna to earth for playback of the recorded data. The sequence will be repeated every 3-1/4 hours for 243 days.

Magellan is a three-axis stabilized spacecraft, and Ulysses is spin-stabilized. Galileo is the first spacecraft to combine the stabilization technologies so that the scan platform can be steadily pointed at its targets while the magnetic field and particle experiments, which can acquire better data when spinning, will move at three revolutions per minute.

Electronic Engineering Times — Monday, July 14, 1986 -

Ariane Delayed To 1987; Ignition Problems Cited

By Roger Woolnough

PARIS — Ariane, the European space launcher which failed on May 30, is not expected to resume operations until 1987.

Frederic d'Allest, chairman of Arianespace, announced the new timetable last Monday during a discussion of a report by a board of inquiry on the explosion. The board was set up by the European Space Agency and Arianespace after the Ariane V18 launch was destroyed from the ground by engineers who detected a fault in the third stage of the unmanned rocket. The rocket was carrying the Intelsat V F14 communications satellite.

No Evidence Of Faults

The preliminary report of the board says it found no evidence of any manufacturing faults in any item of hardware of the engine or propulsion unit. And d'Allest virtually ruled out sabotage. Although this could never be totally excluded, he said, there was no reason to lend much credence to the possibility.

Several factors led the board to believe that a first partial ignition occurred, but that propagation of combustion did not take place under normal conditions.

A second ignition 0.12 second later, occurred at an abnormally high pressure level, and this caused a high-pressure leak and an engine shutoff.

Board Recommendations

Among the board's 14 recommendations, it is calling for further studies of the ignition conditions, and redefinition and qualification of a more powerful third-stage igniter.

It also recommends a schedule of firing tests in simulated flight, designed to validate the new ignition conditions and the engine for flight V19, and a review of the third-stage engine acceptance process.

At last Monday's press conference, d'Allest said that the launch program will not be revived until tests and simulations have shown the system to be viable.

An exact date will not be set until the fall, but this is unlikely to be before the early part of next year. Before the May 30 failure, Ariane had 33 launches booked over the next three years.

After the Challenger disaster last January, Arianespace made available eight extra launch opportunities in 1987 and 1988 to help meet demand.

Stretched Out

The whole program is now being stretched out. Two launches to be delayed are for the French and West German direct broadcasting satellites.

But the company behind another broadcasting satellite, Luxembourg's Astra, is putting a brave face on the setback. Astra, which is being built for Societe Europeenes des Satellites (SES) by RCA Corp. in the United States, was booked for Ariane's 26th flight.

At the Cable '86 exhibition in Brighton, England, last week, SES said that although the May 30 failure might delay the launch of V26, the company is talking with Arianespace about an earlier launch slot. "The SES satellite will be ready to go up early next year," the company said, "whereas others currently booked earlier might not."

THERE'LL BE SPANDEX JACKETS,
ONE FOR EVERYONE

("I'm living in the future / I feel wonderful /
I'm tipping over backwards...")

Gregory Ruffa
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San Diego, Calif. 92126
(619)-695-8647

* * *

I got back here OK, I seem to be fully functional, and it's the start of a New Year. So I've decided that the optimal thing to do is to opt for optimism. Things can't be too bad if it's a week after the holidays and I'm still in a good mood...

And why not? Things are pretty slow at work right now, so it's been possible to ease back in. Even **too** easy: I pretty much ran out of things to do by Thursday, so I was bumming around, checking on the status of various projects. We gave our presentation on the Medium Launch Vehicle to the Air Force on December 4th, then topped it off with a successful Atlas/Centaur launch at 7 PM our time. (The visitors got special seating in the conference room to watch the satellite feed. Afterwards, the "emcee" told them, "And it will go just that smoothly for GPS." Management **can** lay it on a bit thickly at times... I didn't go at all, which assured that the launch would go well.) All decisions at Space Systems are on hold until the 16th, by which time we'll hear if we get the contract. If so, we'll be sending up a lot of Navstars over the next few years; there is a rumor that the Air Force will even switch AC-68 from launching a FLTSATCOM to a Navstar this summer because they're in such a hurry to get more of them into orbit; there will also be money again by summer to fund internal research. If not, there will be a lot of long faces and more layoffs; that probably won't bother our group much, since we've been shrinking steadily anyhow. Guidance and Control is down to fifteen people and may actually be in trouble on doing work for other programs. We have about fifteen or so students coming through this month for interviews; if we pick up this new program, we'll be hiring like crazy for the summer. So if you want to get into the space program, now's yer chance...

I have a little work to tidy up from last year. Part of it is finishing the manuscript for our paper on manned Mars missions for a conference in May; we have about two months before that's due. I'm also thinking about putting something together for the astrodynamics conference in August, which gives me about six months to do a new project. The company isn't paying anything for this, which makes me glad I started the work on my own computer; now we'll have to see if they'll pay my way there (or I could **not** go and get a free ticket to Worldcon...). We haven't heard yet if we'll be getting the NASA contract for manned Mars mission studies; the problem at the moment is that GD hasn't allocated any funds to pursue this further, so even if we **do** win, we can't send anyone to make the final arrangements or set up a group for the project. It isn't easy on an optimist like me when you work around here.

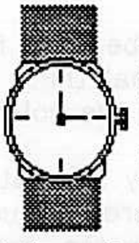
Sometime soon, I'll be starting work on the post-flight analysis of AC-66. The next launch, #67, is an identical mission and is presently scheduled for February 26th, unless the Air Force changes its mind about something again. Unless #68 is grabbed for Navstar, it's supposed to go in May; then, that'll be it for Atlas/Centaur for the forseeable future. Lots of people in my group are getting ready for assignments on Titan/Centaur, which will start launching in around two years; it's possible I might be doing something with that later in the year, if they get desperate for people. I'm keeping a couple of letters ready at the moment: if we get the right answer next week, I'll hold on to them a while; otherwise, they get sent immediately. In any case, I am taking steps to leave here before the year's end.

There -- managed to get through a whole page without saying something cynical. This optimism stuff ain't half-bad. Maybe I can hold out for a whole month like this! Hey, gimme another shot o'that, Doc...

* * *

With work as slow as it is right now, this item in our house organ busted me up. Notice that Management has a funny idea of what constitutes a "brief" session. They could stand to take a course in learning to manage their time...

(And, yes, their 'zine uses Macintosh graphics...)



TIME MANAGEMENT WORKSHOP

Do you find yourself wishing there were more hours in the day? Are you a good time manager of the time that is yours? The Time Management Seminar, may be what you need. It is a brief, informative workshop designed to provide techniques helpful in minimizing demands placed upon your time.

A Space Systems Division Director's comments: ***"Glad I came. Met my expectations. Need to have everyone in the Division experience this first hand. I intend to support this with my folks attending and contributing. Keep up the good work."***

The workshop will be offered on January 14, 1987, from 8:00 to 11:30 a.m. If you are interested in attending, please notify your supervisor.

* * *

The local AIAA Section, for which I am currently trying to pound out another issue of the newsletter (a real monster this time), is having a bunch of interesting meetings this season. Next month, we have someone coming down to talk about the National Aerospace Plane ("It's an airplane... it's a rocket... it's two, two..."). In March, James French, formerly at NASA Ames and now with the American Rocket Company (sounds like something in a Thirties pulp about a group working in a converted bicycle shop), will be speaking on manned Mars missions (I **told** the Council we could get someone locally). [No disrespect meant to the ARC -- that name just sounds so stolid and reliable and **dated**...] We **do** have a local person, who's also a "wheel" in the local L-5 group, talking about space resources in April. This will all be a nice counterbalance for all the aviation stuff we got **last** year.

It was good to be back home in New Jersey last month, where I didn't have to do much more than recuperate, catch up on some reading, and occasionally amuse my nephew and niece once I was up to it. They are both "active and curious," which doesn't make things easy on my sister, now that she is a single parent. (My mother politely does not remind her of how hard **she** was to raise between the ages of 13 and 18; the way I look at it, Karma works!) My nephew's interest in machinery continues unabated, with special emphasis on railroad trains and road construction equipment. His sister, who is about two years younger, is of a slightly more serious demeanor, but has a lot of the same personality traits and likes a lot of his toys. I figure that, circa 2015, they'll be out there building cloverleaf expressways in Mare Imbrium or maybe Syrtis Major.

One highlight of general interest was the day I spent in Easton, Pa. with Doctor Guy ("**you** know, the doctor guy..."). Since we didn't have any spare transportation at my house, he actually made two round trips to bring me there and back (Kid, I'll take **that** as my Christmas present). He showed me his rooms, which are about half the first floor of McKelvy House; it's a nice, big old house, built by a feller who evidently felt it was important to have such things as a film screening room upstairs. We talked about all sorts of things, it having been a bit over three years since we'd been in the same place, including the "pleasantries" of being Housemaster to a couple dozen undergraduates. He showed me around the campus and through the physics area; at his office, I got a look at the three books he's working on. Easton seems like a pleasant, comfortable-sized town to live in. Of course, as it was the Saturday after Christmas, the campus was rather quiet.

* * *

This past week, while most of you slept, I caused the world to be destroyed in a nuclear holocaust. Several times. And it's all Rolf's fault. He got me this frustrating new game called **Balance of Power**, which simulates the geopolitical situation from 1986 to 1994. For simplifying reasons, it is a bipolar game, for one or two players who may choose being the U.S. or the U.S.S.R. Each is trying to enhance its own prestige at the expense of the other, which involves such amusing activities as backing puppet governments, funding insurgencies, destablizing unfriendly regimes, applying diplomatic pressure, bullying nations into inactivity, and offering treaties. All of this takes place under the menace of global annihilation: if the Other Side takes offense at some political "indiscretion" of yours, they may challenge you on the matter; this can escalate right on up the Defcon ladder. You may back down at any point, but the longer you choose to tough it out, the more prestige is at risk in the eyes of the world. On the other hand, the closer you get to Defcon 1, the likelier it is that the Other Side **will** push that button. If the screen goes black, **both** sides lose. If the world makes it to 1994, the side held in higher esteem by the global community is the winner. In six tries at the beginner's level as the American President, I got to 1994 **once**; if there's one thing I've learned, it's that there are some things it doesn't pay to argue with the Russians about over the phone... It's a lot of **very careful** fun!

I saw three movies at theaters over the last month (I also saw a fair amount on cable, but not much worth mentioning). **The Mission** is a rather powerful historical drama about the fate of the Jesuit missions and the native people in the region along the Uruguay River after the re-partitioning of South America between Spain and Portugal; it is a story told primarily in images and manages to be artistic without becoming "artsy." **The Mosquito Coast** is about an inventive genius who is disillusioned with what he perceives as America's descent into commercialism and "junk culture;" he takes his family to a Central American wilderness and engages in an experiment based on his view of the proper use of human imagination. A major theme, I feel, is about idealism and the amount some people are willing to sacrifice to ideals. The story came through strongly enough in the movie to make me want to read the book; the potential weakness in the film is that there is really only one major character, with everyone else becoming peripheral. The kind of technology that appears in the story made me think that this is a real George Ewing kind of movie; some of you techies should enjoy it... Since my cousin Chuck hadn't seen it and my father would never have forgiven me for going without **him**, I went to see **Star Trek IV** again with them. Now that just about all of you have gone, it's fair game for comments. I thought it was cute but dumb. It's clear they were having a good time making the movie, but I thought some things in it, particularly the ending, pandered too much to the fans. For a contrasting point of view, one of my friends at work felt it pandered too much to the general public.

My chief objections, without criticizing the science (which is too easy), are three. First, our heroes were incredibly sloppy about interfering with "the Past," in comparison to all the previous stories where they've treated with this gimmick.

(A couple of notes on this theme. My friend at work had just seen some clips during the summer and was telling me about the movie. He looked over at me and asked, "What over-used plot device do they use **this** time?" I thought some few seconds and said, "Time whiplash!" Right in one. When I finally saw the movie, it occurred to me that they've been in the same part of the Twentieth Century three times now; how long will it be before they start running into themselves? I was also half-waiting for Dr. Brown and Marty to show up in their DeLorean and offer the crew a lift. It's clear that the Bay Area is a hotbed of time travelling activity: H.G. Wells and Jack the Ripper have also been there and "Hill Valley" can't be far away...) Second, they tried to employ a typical Clarkean enigma without setting it up well at all. The "cigar and soccer ball," as the guys at work call it, came across hundreds of light-years to "trade eights" for a couple minutes with the cetaceans, and then **leaves**? What kinda "indistinguishable from magical" bozos are Out There? It's as if the entire motivating force for the plot is ultimately rather unimportant; that's OK for Douglas Adams, but not for a show **this** pretentious. "They came from a far-away world to kaffeeklatsch..." Third, the people behind all of this have labored very hard to erase all vestiges of twenty years of character and plot development. Everybody's back together again in the **same** ship, just like nothing ever happened. Well, maybe they can't wipe out all the changes: people **do** age and relationships change. You realize, of course, that the **Enterprise** now has the highest-ranking bridge crew of any ship in the Fleet: three captains, a couple of commanders...; so who goes for sandwiches? I can already see the marquee in the summer of '88: **Star Trek V: The Ego Crises**; the first half-hour is spent with formerly good friends fighting over the center seat. As my friend says, "That's the trouble with Starfleet: there's no room for career advancement!"

* * *

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Now **this** is what I call Service!

(But here's a person who could really use a good night's sleep...)

* * *

MAILING COMMENTS

APA-TECH 46

Cover Well, at least it doesn't have another rocketship on it... someone gonna **explain** this one?

Sheila Is it true that funds realized from the sale of those stickers is used to support the use of invisible starships against whaling vessels?

Is that the same Uncle Owen who wouldn't let you go to the Academy for so long?

Amorphous Guy It's interesting to hear your remarks, speaking as a computer engineer, concerning the Macintosh -- evidently, it's not a machine aimed at those who know Too Much about computers.

We'd **love** to hear whatever you can say about Imaging Systems.

Oh well, just one more berserker I can't get to...

Don't get too excited about those lunar fusion plants yet. I was talking to Cordell the week I left and mentioned the subject of helium-3 on the Moon. It seems that the concentration is down in the parts per billion, so you'll have to plow up a **lot** of regolith to keep your reactors going.

Planetary Guy We're working on the Martian correspondent problem now...

I guess I've already talked to you about some of your questions. For those interested, the entire July 4th issue of **Science** is devoted to early papers on the Voyager-Uranus mission. I'll send you copies of relevant **Aviation Week** articles on NASA's plans. Basically, the next ten years at NASA are: GET THE $%@#& SHUTTLE WORKING AGAIN; buy some regular-type rockets (nothing fancy); clear the launch backlog; put up the Space Station (nothing fancy); build the Aerospace Plane; and do some exploration if there's any more left.

One hardly realizes what a narrow pipeline the Shuttle is until one tries to stuff the Space Station through it, so it's hardly the thing for any heavy-duty space development. Interplanetary exploration through 1995 from this country will be Voyager-Neptune, Magellan, Galileo (if we're real lucky), Mars Observer Mission, and maybe CRAF. Yessir, it's truly the Age of Iron in American planetary studies: one leftover (two, if you count ICE), two probables, and two possibles since 1981.

To try to reply to your list of questions briefly here (these are scarcely The Answers):

A - I believe the NASA Charter says it's supposed to be an R&D outfit, which it pretty much was until it got the Shuttle launched. A developmental vehicle got declared operational after four test flights (!) and the agency got itself trapped into being a truck dispatcher.

B - After the Apollo hoohah, it seems to me that NASA got forced to pick **one** big project to work on in vehicle development because that was all the money they were going to get. The next step was supposed to be a "heavy-lift" vehicle -- the successor to the Saturn-V -- **and** the Shuttle (like the Hermes), so we could build the Space Station and bases on the Moon, go to Mars, etc.

This coincides, in my mind, with the American love affair with business management during the Seventies, when we decided to have our industries and government agencies administrated to death, giving the rest of the industrialized world the fifteen years they needed to catch up with us. (Westar-6S on a Long March 2?!) A fellow I know at GD who worked at Goddard in the Sixties came to California in the mid-Seventies because "it wasn't fun to work at NASA anymore." (You don't see me applying for a job there.)

The managerial era can be shown to have brought about a lot of weak or faulty decisions that produced results like the one to override engineering safety margins and launch Challenger. Fixes for the Shuttle will be kludged-up and launches will resume, but **all** the technical problems will not be solved; not enough will be spent to fix most of them. As to NASA's other problems, look who's been put back in charge -- don't expect much to improve before '89, when the Shuttle will be going again and Reagan and Fletcher will be safely retired...

It is my opinion that only inept leaders tell us to "lower our expectations." Maybe we can't expect much from them, but the whole country didn't get weaker and more stupid in the last ten years!

C - NASA's still chewing over what it'll do in the next decade. When you have to guess what will be funded from year to year, it makes solid decisions difficult. The only distinct words heard in the mutterings are "Space Station" and "Aerospace Plane." What do we want **those** for? DoD has some really **neat** ideas. Why do we want people in space? Because the Russians have them.

D - "Private industry take over space? You mean, spend all our **own** money on the research and development to go to the Moon or Mars?! *sputter choke*

Are you MAD, sir?" I began to realize around 1982 that Heinlein had deluded himself -- he must have pictured that Henry Ford was going to come along in his Quadricycle and fly us all into orbit. I think it still hasn't sunk into the heads of a lot of "enthusiasts" that the space endeavor, as they envision it, will be unprecedently difficult. It is the **biggest** thing we humans have ever attempted, we'll have to provide **everything** ourselves, it is an utterly unforgiving enviornment, the space infrastructure will be vast and intricate, and we will need to invent completely new methods to coordinate and manage all of it, or it will just get away from us. Seven people killed in a Shuttle explosion won't even look like a down payment on this. There is **nothing** we've done before that is analogous: every strange place we've gone before was still Earth.

When I say this to some people, they think I'm being totally negative and claiming it's all impossible. I believe, in time, we'll learn how to move out into space and, who knows, we puny humans might conquer the Galaxy yet. But there seems to be insufficient appreciation of the size and nature of the task. The industrialized world and the whole blamed species have a lot of growing up to do first.

E - Why should the teachers care? If this country and this so-called civilization are going to have any future at all, in space or otherwise, they'd better start getting students more interested in becoming literate, educated, critically-thinking citizens, instead of Good Consumers or Good Little Children who only read the Right Books...

On bad days, I begin to think these questions are irrelevant; with the kind of nonsense that's being allowed to run unchecked in this country lately, America may not have to concern itself with a future extending much into the next century...

* * *

Phew! Well, that was certainly a nasty passage. I wrote that last month when I was feeling **especially** negative and cynical. In my present optimistic frame of mind, I suppose I should have edited it, but I guess I still mean a lot of it and feel like being provocative. It's sure hard to look at some of what's going on and remain upbeat. Gimme another hit off that there, Chief...

I still have another couple pages of comments on the last issue, but I'm going to hold them up so I can get this all on its way. Since Cap'n Al has a bunch of clippings on space stuff in his 'zine, I've decided to revive the practice here also (I'll admit to that). To try to keep it under some control, I'm going to select only the more interesting topics, even though that still ran to a lot of pages in December. If you think that just clutters up the APA, please let me know and I'll stop doing it.

We're getting ready out here to welcome our two special visitors from the Midwest. That's right -- Teddy and Grubby will be flying out here in just a very few weeks for our own local SF convention. This will be so exciting! Oh yeah, and they're bringing along a coupla guys named Bill and Barry -- those'd be their trainers or somethin', I guess. Anyway, they'll be here February 6th and that comic duo will go through their antic paces Saturday afternoon. I know I'm looking forward to it! (I also know I'm going to get two socks-in-the-jaw for writing this goofy paragraph...)

Well, that's fine. I'm going to go lie down now and wait for all this good-naturedness to wear off so I can be ready for work tomorrow. Happy New Year! Best Wishes! Take care. See ya real soon. Don't let the bedbugs bite.

New Launcher Concept Bridges Shuttle-Aerospace Plane Gap

By Craig Covault

Washington—The National Aeronautics and Space Administration is defining a new manned launch vehicle that could be operational before the space shuttle fleet is retired, bridging the gap between current manned operations and those planned for the National Aerospace Plane.

The project, designated Shuttle 2, could be conducted parallel to the National Aerospace Plane development but would offer a near-term, lower-risk alternative for manned launch, NASA engineers believe.

The Shuttle 2 vehicle would be used extensively for space station logistics. It would exploit new, lightweight materials and other developments emerging as part of the aerospace plane program, but would use rocket propulsion exclusively instead of air-breathing engines.

Shuttle 2 powerplants would be developed with largely proven technology, while the aerospace plane's advanced supersonic combustion ramjets involve much higher technical risk and will take longer to enter operational service.

NASA Phase-A conceptual design contracts for the Shuttle 2 project could be awarded next year.

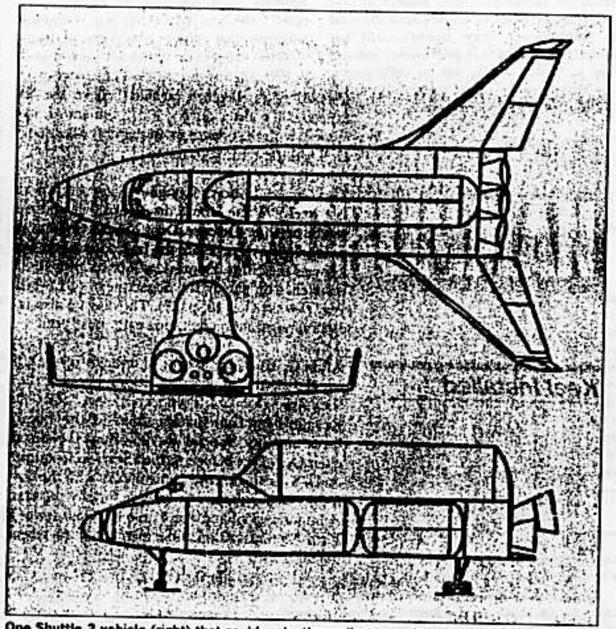
The timing of the Phase-A contract awards will depend on the outcome of in-house NASA studies, as well as findings from the National Space Transportation System Architecture study recently sent to the White House by NASA and the U. S. Air Force.

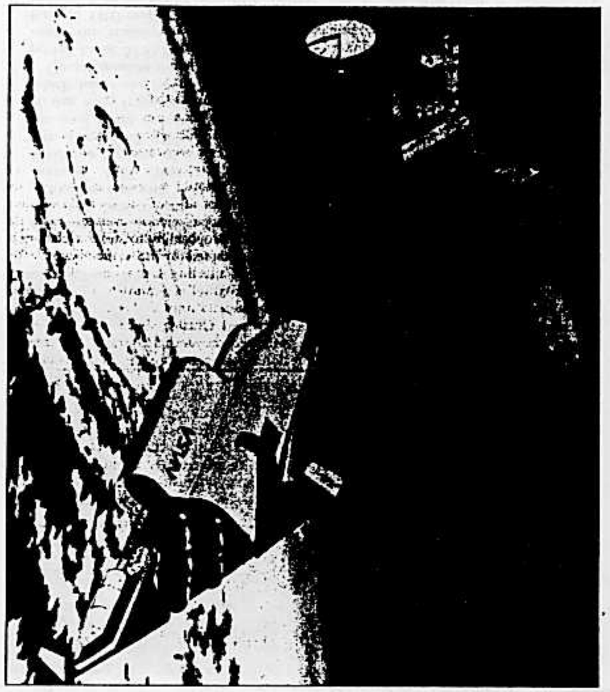
NASA's Shuttle 2 concepts were not developed as part of the joint architecture studies, but some similar industry concepts were.

If Phase-A industry contracts are approved in 1987, they could lead to Phase-B advanced design studies by 1990-91 and vehicle procurement approval about 1992. First flight of a full-scale Shuttle 2 would be no earlier than about 2000.

In contrast, the first flight of the X-30 subscale aerospace plane test aircraft cannot occur until 1993-94 at the earliest, and it would be many more years before a full-scale operational vehicle could be developed.

Like the aerospace plane, one goal of the Shuttle 2 is single-stage-to-orbit aircraft-type operations, although the second-generation shuttle would be launched vertically instead of horizontally. Two-stage options also are being studied, but these still would incorporate more aircraft-like operations to reduce operating costs.





One Shuttle 2 vehicle (right) that could make the earliest use of aerospace plane technology would be 163 ft. long and capable of delivering 20,000 lb. to the space station. Another version could carry 40,000 lb. (above). Both vehicles have large cargo pods. In illustration at right the vehicle is deploying a payload from the back of its pod.

The White House, Defense Dept. and NASA will need to make tradeoffs between mission roles for the aerospace plane and Shuttle 2 concepts, since the vehicles have somewhat similar objectives—although they are not necessarily redundant in terms of their mission or technology availability.

The loss of the Challenger earlier this year and subsequent reduced use of the shuttle fleet also have been factors in the Shuttle 2 studies, focusing on the need to bring a new U. S. manned vehicle on line relatively early.

Prior to the Challenger accident, NASA's plan for 24 shuttle flights per year would have resulted in each orbiter reaching its airframe retirement date in about 2002, after 100 missions.

With the flight rate reduced by 50% and a new orbiter due to enter service about 1992, the airframe limit will not be reached until 2010 at the earliest, according to Ivan Bekey, NASA director of advanced programs. However, "we may be driven to a less-expensive manned vehicle before the current fleet wears out," he said.

NASA officials believe the Shuttle 2 concept responds well to increased pressure on lowering launch costs and an emphasis in NASA and the Defense Dept. to separate heavy cargo and manned launch operations by about 1995.

NASA engineers believe their experience with advanced rocket concepts could enable a Shuttle 2 vehicle to achieve significant cost savings in manned operations. A key factor will be use of aerospace plane structures technology to help make possible a lightweight vehicle that can lift a payload nearly equal to its dry weight. The current shuttle can lift only about 10% of its dry weight.

Langley Research Center is studying Shuttle 2 functions and design, and the Marshall Space Flight Center has already begun definition of the engines, Bekey said.

In-house NASA assessments of Shuttle 2 were begun just before the Challenger accident, which has changed many factors. The study is about half complete, and new efforts in early 1987 will focus on identifying specific vehicle designs and making cost estimates.

Engine definition includes liquid oxygen/liquid hydrocarbon and advanced oxygen/hydrogen concepts. A dual-fuel engine in which both hydrogen and hydrocarbons could be burned also is a possibility, according to Bekey.

Unlike the shuttle main engines, which operate close to design limits, the goal for Shuttle 2 would be to design and operate powerplants with wide margins, lengthening life and reliability. This could result, for example, in designing for 100% thrust and operating primarily at 80%. Another key goal would be to use the same propellant for launch and orbital maneuvering.

NASA studies projected a variety of technology gains that together could reduce dry weight by 15%, 30% and 60%, respectively, compared with existing shuttle designs. Specific areas include:

- **Propulsion**—Use of dual fuels in separate engines would contribute to a 15% weight reduction in comparison with the shuttle. Integral engines using dual fuels would help save 30% in dry vehicle weight, and advanced lightweight engines would help save 60%.
- **Structures**—Advanced composite structures with warm/cold capabilities would help save 15% of overall vehicle weight, while warm composites and aluminum/composite propellant tanks would help save 30%. Use of new metal-matrix materials, a hot-structure operating capability and actively cooled leading edges would help push weight savings to 60% compared with the current shuttle.
- **Subsystems**—An all-electric advanced control-configured design would help save 15% in vehicle dry weight. Artificial intelligence systems, common nontoxic propellants and adaptive flight controls would contribute to a 30% savings. Use of advanced lightweight subsystems in areas such as the landing gear and auxiliary power units would contribute toward a 60% weight reduction.

To save ground costs, simplified operations would be introduced in the vehicle design. The vehicle would be erected from a self-contained transporter after being serviced much like an aircraft, and it would be capable of launch with minimal ground support. There would be no launch towers or complex control center.

With a move toward use of heavy-lift unmanned expendable boosters to launch large cargos into space, a critical question in the Shuttle 2 definition study has been how much of that cargo may need to be returned to Earth. This issue would seriously influence the size and cost of the manned vehicle.

But many payload planners now believe there will be little justification for returning many large payloads to Earth. Most will be refurbished in space, or discarded once their useful lifetimes are completed. This means the next manned vehicle need not be designed for such large payloads, unlike the current shuttle.

"Now we should design a vehicle that is optimized for people, and not carry so much cargo," Bekey said. "Doing that, we may be able to design a vehicle that is much cheaper to fly. If we can cut the cost from $100 million per flight to $20-30 million, there would be a big incentive to operate it frequently over the long haul."

No payload capability has been determined yet, and ranges of 3,000-50,000 lb. are being studied. The current shuttle's capability is 65,000 lb.

Although Shuttle 2's goal is single-stage-to-orbit with a vertical launch, a two-stage capability could be adopted at first using a glideback booster.

Detachable payload canisters would be on both single- and two-stage vehicles to provide much greater flexibility in payload processing and vehicle operations. Passenger seats, ejectable cargo or stowed cargo could all be carried using different pods. ☐

Soviet Shuttle

The Soviet Union has completed first tests with its space shuttle on the launch pad at Tyuratam, a significant milestone toward first flight of the vehicle. U. S. imaging reconnaissance satellite pictures showed the Soviet orbiter was mounted piggyback to its heavy expendable launch vehicle for a series of fit checks. The Soviet orbiter was removed from the launch pad after the tests. U. S. intelligence officials believe the Soviets will attempt first launch of the heavy expendable booster during 1987, unmanned, using its piggyback cargo pod. The first manned launch, with the orbiter mounted to the booster, is expected in 1988 at about the same time the U. S. shuttle returns to flight.

Europeans Propose New Comet Flyby for Giotto Spacecraft

By **Jeffrey M. Lenorovitz**

Paris—A second comet flyby for Europe's Giotto Halley probe has been added to a competition for the selection of a new space science mission to start in late 1988 or early 1989.

A Giotto flyby of comet Grigg-Skjellerup in 1992 will join six other missions under consideration as new starts in the selection process, which is to be completed in late 1988 or early 1989.

The decision to add the Grigg-Skjellerup encounter to the competition was made at a meeting of the European Space Agency's Science Program Committee here in November.

If approved, the flyby could bring Giotto to within several hundred kilometers of the comet nucleus for imaging by the Halley Multicolor Camera, which has a resolution up to 5 meters (16 ft.). Closest approach to the comet would be July 14, 1992 (AW&ST Nov. 17, p. 42).

Other missions that will compete in the selection process are the NASA/ESA Cassini Saturn orbiter and Titan probe project, GRASP gamma-ray astronomy program, Quasat radio astronomy mission, the Lyman ultraviolet astronomy spacecraft, Caesar comet coma sample return flight and the Vesta Mars/asteroid/comet flyby mission proposed by France in cooperation with the Soviet Union.

ESA officials said the future of the Lyman and Quasat missions is in doubt because a collaborative plan with NASA on the two programs has been abandoned by Europe owing to the uncertainty of the U. S. Explorer spacecraft series.

Quiet Cruise Mode

The Grigg-Skjellerup encounter is dependent upon verification of Giotto's operating status following the dust damage suffered during the probe's high-speed flyby of Halley's Comet last March. Giotto has been in a quiet cruise mode since the flyby, and the spacecraft would need to be reactivated for a checkout of its on-board systems and of the Halley Multicolor Camera.

ESA's Science Dept. faces stringent funding constraints for its overall budget, and it is not clear where the money could be found to pay for the switch-on and checkout. The agency's Science Program Committee urged at its meeting in November that the money come out of the science program budget to which all member nations are required to contribute. The matter has been referred to ESA's Management Council, which will meet again this month.

German experimenters also have proposed that Giotto be used for radio science experiments to conduct a sounding of the solar corona electron distribution in winter 1987/88 when Giotto passes behind the Sun as viewed from the Earth.

European space program officials said Germany would be expected to provide most—if not all—of the money necessary for the radio science evaluations if the German proposal is to have a chance of being accepted by ESA members.

At its meeting last month, ESA's Science Program Committee also approved the continuation of development for its Soho and Cluster space missions, which will become cornerstones in an international research program on solar-terrestrial science involving Europe, the U. S., Soviet Union and Japan.

The committee's approval for Soho and Cluster confirmed ESA's commitment to the two missions after strict efforts were made to control rising program costs.

Soho and Cluster are core elements in a new solar-terrestrial science initiative by the Inter-Agency Consultative Group for Space Science (AW&ST Nov. 10, p. 28). About 15 spacecraft are expected to be launched through the 1990s to provide data on Sun/Earth interactions.

"The Science Program Committee support given to the Cluster and Soho missions is an extremely positive step forward," David Dale, ESA solar/terrestrial science program manager, said. "The only question is how we can do the program and maintain the costs at a reasonable level."

Soho's goals include measuring the spectral and total luminosity of the Sun, providing data on the Sun's interior by monitoring the velocity and luminosity oscillations of the solar surface, and investigating the Sun's outer layers. The three-axis stabilized satellite is to be placed in orbit around the L_1 libration point for continuous viewing of the Sun.

Mission goals for the spin-stabilized Cluster satellites include exploration of the Earth's magnetosphere and investigation of the bow shock.

Both missions are to involve cooperation with NASA. For example, NASA is to handle flight operations for Soho and will provide test/integration facilities for the spacecraft.

Cluster and Soho are planned for launches in 1994.

Because of rising program cost projections, the initial Cluster concept of building one main and three companion spacecraft has been dropped in favor of building a series of identical satellites. Their scientific payloads have been reduced from about 70 kg. (154 lb.) for each Cluster to 45 kg. (99 lb.) for cost control reasons. □

TDRS, Ground Antennas Link for Radio Astronomy Observations

By **Michael A. Dornheim**

Los Angeles—An international team led by NASA's Jet Propulsion Laboratory made the first radio astronomy observations using an antenna on the NASA/TRW Tracking and Data Relay Satellite (TDRS) in conjunction with ground radio telescopes in Australia and Japan, giving better resolution of three quasars than that possible using ground devices alone.

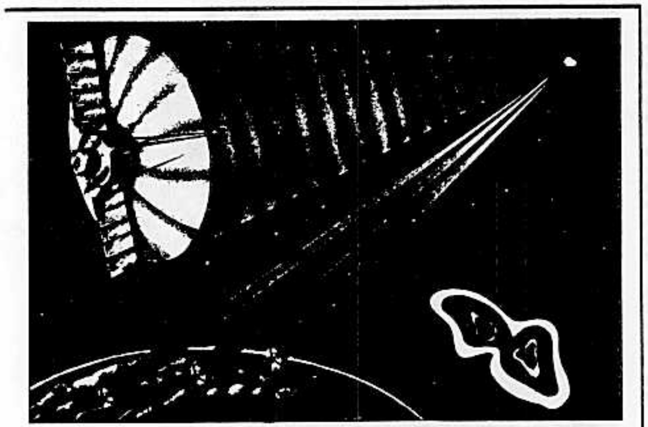
A very long baseline interferometry (VLBI) technique was used to combine signals from the three antennas to accurately locate the quasar sources, and this was the first time a satellite was used with this technique. The TDRS in geosynchronous orbit allowed the baseline distance between antennas to be increased from one Earth diameter to 1.4 Earth diameters in the July-August experiments, which improved resolution proportionately to 0.002 arc-sec.

The experiment's success demonstrates the feasibility of a proposed dedicated radio astronomy satellite called Quasat, says J. Frank Jordan, JPL Quasat study manager. Quasat has been under study by NASA and the European Space Agency for four years and is a possible new start in the NASA Explorer series of science spacecraft (AW&ST Apr. 7, p. 15; May 9, 1983, p. 59).

Current Quasat design has a 15-meter-dia. antenna to receive signals on the radio astronomy bands at 320 MHz., 1.4-1.6 GHz., 5 GHz. and 22 GHz.—the last a frequency emitted by water molecules. The 64.3-deg. inclined orbit is elliptical with a 6,500-naut.-mi. apogee and 5.3-hr. period, which combines with Earth radio telescopes to give baselines along a variety of axes. The diverse baselines allow imaging of most of the heavens, in contrast to the limited baselines available with TDRS.

Quasat would be used primarily with the National Radio Astronomy Observatory very long baseline array of ten 25-meter antennas located in the continental U. S., Hawaii and the Virgin Islands that is set for completion in 1992.

The TDRS experiment proved that it was possible to locate and send a synchronization signal to a satellite with sufficient accuracy that the VLBI technique could be used. At 22-GHz. receiving frequencies, VLBI needs a reference signal with several parts in 10^{14} accuracy, which can be provided by a hydrogen maser. However, such a device is not space-qualified, so the reference signal has to be sent to the satellite by radio. Atmospheric scintillation of the signal was the main concern, but proved to be compensatable.



Proposed Quasat radio astronomy satellite would be used in conjunction with ground radio astronomy antennas to map radio sources throughout the heavens. Quasat's inclined elliptical orbit would combine with ground sites to give very long antenna baselines in a variety of directions, yielding the sort of fine resolution needed to separate two closely spaced radio sources, as shown in this artist's concept. Fifteen-meter-dia. antenna on Quasat would listen at frequencies from 320 MHz. to 22 GHz.

TDRS absolute position in the experiment was known to 20-30 cm. along the line-of-sight to the White Sands, N. M., ground station and around 1 meter along the perpendicular axes. Fluctuations in position were known to about 1 mm. Position of ground radio astronomy antennas is known to about 5 cm. in all three axes, and satellite line-of-sight can be this accurate with further calibration.

Another test with TDRS is planned for January, 1987, that will attempt to achieve a baseline of 2-2.5 Earth diameters. The TDRS 4.9-meter S-band antennas used in the experiment can only look 30 deg. away from straight down at Earth, which limits the baseline length.

Quasat mission development cost is expected to be $150-200 million, which exceeds the traditional Explorer program limit of $100 million. The plan is to split the cost between NASA and ESA. Quasat may be launched in 1994-95 if approved in 1989, but funding shortages could delay the decision.

The Soviet Union discussed international participation on a Soviet VLBI satellite, called Radioastron, at a meeting of the Inter-Agency Consultative Group in Rome, Italy, last month (AW&ST Nov. 17, p. 45). Radioastron is to have a 10-meter antenna operating at frequencies including 320 MHz., 1.6 GHz. and 5 GHz., and is set to be launched in the early 1990s into an elliptical, 37,800-naut.-mi. apogee, 24-hr.-period orbit that is roughly synchronous over Soviet ground stations.

U. S., Europeans Hold Further Talks On Space Station

Washington—U. S. and European space station negotiators meeting here last week continued to air strong differences, but the negotiations generated a more cooperative tone than talks in late October. More extensive participation by White House and Office of Science and Technology Policy officials is expected in the negotiations as they proceed into next year.

Japanese space officials begin a new round of negotiations here this week with the U. S., involving some of the same concerns causing difficulty between the U. S. and Europe (AW&ST Nov. 24, p. 16).

European Space Agency Director Reimar Luest met with NASA Administrator James C. Fletcher Nov. 21 for consultations prior to the negotiations. The two said they had directed their staffs to "make every possible effort to resolve [differences] in a timely manner."

U. S. and European space officials emphasized the importance of the word "timely," indicating recognition of a general deadline that exists for both sides to achieve station milestones and that serious differences remain.

In addition to the meeting with Luest, Fletcher also met with Frederic d'Allest, director general of CNES, the French national space agency, and president of Arianespace.

D'Allest told Fletcher that European space officials are genuinely frustrated by the U. S. position on station management and cost.

Both Luest and Fletcher said the differences, however, are not irreconcilable. Observers said the discussions focused on how the differences could be remedied rather than simply restating firm positions.

The negotiations Nov. 24-25 between U. S. and European teams centered on how each side views the Intergovernmental Agreement (IGA), which is a blanket document covering station principles. The European delegation, headed by West German representative Reinhard Loosch, continued to stress the need for this document to provide stronger operational guidance than desired by NASA.

The U. S. team, headed by Robert Morris, deputy assistant secretary of State for science and technology affairs, believes station points should be guided by a memorandum of understanding between NASA and ESA. Meetings on the memorandum are set here for Dec. 8-9.

At the outset of negotiations, the European representatives were willing to adjust some of their IGA objectives to ensure they do not usurp NASA's functions in relation to other U. S. agencies. □

VIEWPOINT

Financial Impact of Challenger On Space Industry Analyzed

John Egan is executive vice president of the Center for Space and Advanced Technology (CSAT), an Arlington, Va.-based consulting firm providing services to NASA and companies involved in commercial space activities. Prior to joining CSAT, Egan was the director of the Commercial Space Consulting Practice of Coopers & Lybrand. He specializes in business planning and financial and market analysis for the space industry.

Since the Challenger loss, the pages of AVIATION WEEK & SPACE TECHNOLOGY have chronicled the impact of that tragedy on NASA and the U. S. space program. But what impact has it had on the commercial development of space and the companies that were heavily involved in it?

Did the Challenger accident impact match that of Three Mile Island on the nuclear power industry, or have its effects been less profound and enduring?

To date there is no broad agreement on the answer; the views expressed by industry players depend upon where they sit. The shock has passed, and we have had time to begin to assess the impact of the tragedy from a number of perspectives.

These include the viewpoints of investors toward companies involved in the space program as reflected in the performance of their stocks, of proponents of space-related R&D programs within major companies and of the newer space entrepreneurs.

Stock Price Reflection

Classic financial theory suggests that, given perfect information, changes in stock prices will accurately reflect the impact of an event on a particular company. While one might argue that information about the Challenger accident was imperfect, it certainly was prolific.

An analysis of the effects of the accident on the stock price movements of several aerospace firms involved in the space program yields some interesting insights. A more precise analysis would require taking into account individual risk/return relationships as well.

However, because the dividends of these firms did not change markedly over this period and the riskiness of individual stocks remained about the same, it seems valid to use price changes as a measure of investor reaction to the news and impact on the firms.

Of six aerospace companies studied, the four most closely associated with the shuttle program—Martin Marietta, McDonnell Douglas, Morton Thiokol and Rockwell—saw a price drop the day of the accident. Two more broadly based companies less associated with the shuttle—Boeing and General Dynamics—enjoyed the same kind of gain the general market did. On the following day, the prices of McDonnell Douglas and Rockwell began to recover as news of the accident's cause centered on the solid rocket boosters and the external fuel tank. Over the six-month period following the accident, all of the aerospace companies except Morton Thiokol showed gains.

Three company-based commercial space R&D programs touted in press accounts prior to the accident were the electrophoresis program of McDonnell Douglas, the major experiments in organic and polymer chemistry at 3M and the metal casting work of the John Deere Co. The prices for 3M and Deere gained on the day of the accident after sustaining losses the previous day. This suggests that the market did not view the space R&D portion of either company's business as significant enough to affect its stock value and that the previously mentioned loss incurred by McDonnell Douglas may have had more to do with its role as provider of space hardware, such as PAM-D, than with concern for delays in its electrophoresis program.

In comparing the percentage of change in stock prices for these companies with the general market between Jan. 27 and the end of July, three of the aerospace companies significantly outperformed the general market. Boeing was helped by substantial profit improvement based on aircraft sales, Martin Marietta in all likelihood benefited from the fact that Titan expendable launch vehicles would be needed to service the mixed fleet and Rockwell profited from the probability that it would build the replacement orbiter.

General Dynamics and McDonnell Douglas, while showing gains, were below the market average, no doubt in part because of the loss of an Atlas Centaur and a Delta rocket, the cancellation of the shuttle/Centaur program and poor short-term prospects for PAM-D sales.

Only Morton Thiokol, clearly affected the most, showed a loss. But even for this company, the long-term outlook is not that gloomy.

Moody's Handbook of Common Stocks reported last summer: "Morton-Thiokol's strong portfolio of mixed businesses (including well-positioned salt and specialty chemical operations, as well as strategic and tactical weapons systems that provide over 40% of aerospace segment income) should otherwise perform well, cushioning the temporary loss of some shuttle contract revenue."

During this same period, 3M showed significant gains based on a strong corporate picture while John Deere sustained a substantial loss as a result of layoffs and other information that was not related to its space activity.

Mixed Impact

From the perspective of the market, then, the impact of the accident on these major companies has been mixed. For aerospace companies heavily involved in the shuttle and other space programs, there have been both setbacks and benefits. For companies leading in space experimentation, no impact is evident.

Most of the small companies involved in the commercial space programs, such as Orbital Sciences Corp., are not publicly traded, so no such analysis can be performed. Astrotech International is publicly traded, but it is not entirely a space-related company, for its subsidiaries include specialty metals and computer-oriented companies as well as Astrotech Space Operations, operator of a facility near the Kennedy Space Center to process communications satellites commercially, and General Space Corp., a new venture formed to explore commercial space opportunities, one of which is the purchase of an additional shuttle orbiter. The fact that the accident had no immediate impact on its stock price is puzzling, given the knowledge that a principal money-making subsidiary, Astrotech Space Operations, would be seriously affected by the shuttle loss. Traders may have believed that its stock already was extremely low given the value of the company.

Astrotech's stock rose 175% as the commercial purchase of a replacement orbiter was promoted in Washington by its chairman, Willard Rockwell. When Administration support for such a purchase failed to materialize and reports on the performance of its nonspace divisions proved less than promising, Astrotech's stock fell to its previous low level of $1.00 per share by Oct. 1. It is fair to conclude that Astrotech's stock benefited from the Challenger loss briefly, but not in the long run. Astrotech International recently discontinued operations of its General Space subsidiary, ending its quest to purchase the replacement orbiter commercially.

The shuttle accident did not impact nonaerospace companies. But the question remains of what impact it has had on the advocates of commercial space R&D programs within these companies.

The job of persuading management that there is value in continuing to invest in space research programs, while never easy, grew considerably more difficult. Prior to the accident, several managements perceived real benefits from space-based R&D in the form of basic scientific knowledge and the promise of new and improved products.

Conferences on the commercial development of space were held almost monthly, providing opportunities to share the latest information and to discuss important policy issues. All of this generated support for advocates of commercial space programs as they competed for resources within their companies. NASA programs designed to help companies move ahead with space-based research, including joint endeavor agreements and modified launch service agreements, also were important incentives.

There is no indication that management or the core of outside believers in the commercial potential of space activities has had a change of mind about the ultimate value of space-based research. For now, most are continuing their programs and their advocacy, respectively.

However, companies are less confident that future policy will continue to support long-term space research programs or that their experiments will receive priority once shuttle flights resume. Once this confidence is reestablished, it will be far easier to argue in favor of allocating further company resources for the extensive ground-based experiments that will be necessary for an eventual strong space-based experimentation program—one that will prepare companies for work on the space station.

If NASA fails to give such assurances in the near future, these companies will find other ways to spend their research funds.

Space Entrepreneur Impact

The Challenger accident has severely affected space entrepreneurs, those small businesses that have grown up around the emerging space industry. Some, but not all, have been badly hurt. Astrotech Space Operations, processor of communications satellites for shuttle launch and once hailed as the first successful commercial space venture since communications satellites, has lost virtually its entire market and must pin its hopes on the emergence of a commercial expendable launch vehicle industry.

Orbital Sciences Corp., which raised $62 million to finance the development of a shuttle-compatible commercial upper stage, also has been severely affected. Although OSC won a NASA contract to provide the stage for the Mars Observer mission, difficulties related to the accident may cause delays and program uncertainties that will jeopardize OSC's future. That future is now dependent upon winning contracts for government payloads on future shuttle missions or adapting their stage to a future commercial ELV.

Smaller entrepreneurs who worked with Getaway Special canisters or who provided specialized consulting services are undergoing severe problems. The key issue for all these entrepreneurial ventures is to marshal their resources to last through the hiatus in space flight.

The companies that have benefited are those that have turned to developing alternative launch capabilities. These include major companies as well as newer entrepreneurs. General Dynamics, Martin Marietta and McDonnell Douglas are all looking seriously at commercial applications of their respective launch systems. Hughes Aircraft and Boeing have joined forces to propose the development of the Jarvis launch system.

Smaller companies including Space Services, Inc., and American Rocket also are looking at how they can enter the launch vehicle market. Such vehicles are being taken far more seriously than before. This suggests investment money is available from large companies and other investors for space-related projects for which there is a clear and present need.

Some firms have been helped by the absence of a NASA launch capability, but most have been hurt by the delays. The question is if those companies that are active in and support commercial development in space can hang on through the delays. Most probably can—if they are assured there is a reason to continue.

If the commercial development of space dies in the wake of the Challenger loss, it will not be the accident that killed it but rather the inability of NASA and other government leaders to promptly establish policy that will reassure investors in and supporters of commercial applications that their activity has an important, long-term place in the U. S. space program.

They need to know that there will be a position and priority for them on future flights and on the space station. Without such assurance, even the strongest supporters will be unable to ride out the wait. If support is allowed to dwindle, it will be extremely hard to revive, and both the long-term program and the national interest will suffer. ☐

NASA's Goddard Space Flight Center Uses Massively Parallel Processor

Washington—A massively parallel processor is performing computations at speeds up to 6.5 billion operations per second for the National Aeronautics and Space Administration's Goddard Space Flight Center (AW&ST May 28, 1984, p. 157).

The massively parallel processor (MPP), representative of a new class of computers, was developed in response to the need for faster, large-scale computing machines with power orders of magnitude beyond what was available. Goodyear Aerospace Corp. developed the MPP under a NASA contract and delivered it to Goddard, where it became operationally available Oct. 1, 1985. NASA is seeking proposals to evaluate the performance and uses of the MPP. The first results of MPP applications were reported at a symposium held at Goddard.

The MPP was designed in response to the data processing requirements of NASA's satellite programs. NASA's goal was to improve satellite processing rates by a factor from 10 to 100. Processing rates of billions of operations per second seemed unlikely with conventional methods, so parallel processing was explored.

The MPP functions as a back-end processor for a Digital Equipment Corp. VAX 11/780 host computer. MPP applications programs are prepared in two parts, one running in the MPP control unit and the other on the host computer.

The MPP uses 16,384 simple processing elements in a 128 × 128 array, each performing the same operation on a different piece of data at the same time. The processing elements are controlled and accessed through the host computer.

High performance also results from an innovative staging memory. It provides parallel, multidimensional access to the array unit, with a combined input/output bandwidth of 320 million bytes per second, and can hold 64 million bytes of data.

Parallel processors require communication between processing elements. For image processing, a rectangular array of elements, with near-neighbor communication, matches the picture element structure of an image.

In many applications, data are arranged in multidimensional arrays, and programs require parallel access to the data in several directions—for example, across a row at one time and down a column at another. Handling that application efficiently requires memory that is more flexible than ordinary random access memory.

There are limits to MPP applications and sequential operations are not good candidates. Parallel processing programs are still evolving, but it appears that greater opportunities exist for programs developed specifically for parallel work than for modifications of existing sequential processing programs.

(continued)

Paul Gilmore, assistant to the director for defense systems engineering, Goodyear Aerospace Corp., had identified weather forecasting as an MPP application and this was verified by hard performance data. NASA also found synthetic aperture radar processing a particularly good candidate for the MPP.

The 39 projects briefed at the Goddard symposium broadened MPP applications to include numerical simulations of complex physical and biological processes in physics, Earth science, signal processing and computer science. Results from the first year of testing confirm Gilmore's initial conclusion that the MPP is a very fast, flexible computer that will support a variety of applications. ☐

Harvard Study Gives Mixed Reviews To Post-World War 2 Arms Control

By Paul Mann

Washington—Past U. S.-Soviet arms control accords helped stabilize military competition and lessened uncertainty in each side's threat estimates, but failed to curb arms stockpiles or modernization, a Harvard University study concluded.

The study, commissioned by the U. S. Arms Control and Disarmament Agency and performed by Harvard's John F. Kennedy School of Government, said the past quarter century's attempts at arms control produced no substantial changes in either the nature and size of superpower forces or in curbs on military expenditures and advanced technology. But it said arms control had enabled the U. S. to be considerably more certain in its estimates of Soviet capabilities. Without at least some modest controls, it said, the superpowers would be "far more prone to unrestrained and potentially destabilizing arms competition."

Titled Learning From Experience with Arms Control, the 500-page Harvard analysis said the 1972 Antiballistic Missile Treaty provided a good deal of predictability about the strategic environment. Similarly, the principle in the two Strategic Arms Limitation Treaty accords of not thwarting each other's satellite and electronic surveillance had lessened uncertainty about the other side's evolving military posture.

The study asserted that "projections of opposing forces would have included a large margin of error—a margin far larger than anything caused by compliance-related controversies—without these pacts in place."

Even so, it acknowledged that "the contributions of the ABM treaty, arms control's chief accomplishment, are of debatable significance and durability. The treaty may merely have codified the postponement of a race in defensive systems until advancing technologies made effective defenses possible."

The study was edited by Albert Carnesale and Richard N. Haass, both of Harvard. They developed it using five case histories:

- The Limited Test Ban Treaty of 1963, in the Kennedy Administration, prohibiting nuclear testing in the atmosphere, under water and in space. This differed from subsequent agreements in that it focused on military research and development rather than the number and structure of weapons deployed.
- The Accidents Measures Agreement of 1971 in the first Nixon Administration, a follow-on to the 1963 Hot Line agreement that laid the groundwork for dealing with a nuclear weapons accident or unintended nuclear conflict.
- The Strategic Arms Limitation Treaty (SALT I) Interim Agreement on Offensive Arms of 1972 in the first Nixon Administration.
- The Antiballistic Missile Treaty of 1972, also in the first Nixon Administration.
- The SALT 2 Treaty of 1979, signed by the Carter Administration but never ratified because of the outcry over the Soviet Union's invasion of Afghanistan later that same year.

The bulk of these accords was consistent with the status quo of U. S. and Soviet modernization programs, Carnesale and Haass said.

Yet they also argued that, given the step-by-step approach of seeking to codify a rough balance, reduce tensions and pave the way for more extensive controls, these five agreements had been of some benefit to both countries.

Ultimately, they said, arms control failed to fulfill the expectations of either optimists or pessimists. "The stridency of the debate, however, provides little clue to this modest reality; proponents and critics, liberals and conservatives, hawks and doves—all seem to exaggerate the potential and actual impact of arms control. If the history reveals anything, it is that arms control has proved neither as promising as some had hoped nor as dangerous as others had feared."

Neither the Limited Test Ban Treaty nor the Accidents Measures Agreement had any discernible effect on arms competition, the study said. Further, the facts tend to support the allegation that both SALT 1 and SALT 2 codified existing inventories and plans.

In particular, SALT 1 did nothing to affect the emergence of the new MIRV (multiple, independently targeted warheads) technology. Nonetheless, in the years after SALT 1, both sides could have built up forces far beyond the treaty's ceilings. SALT 2 allowed modernization but required the signatories to retire some weapons that otherwise might have remained operational. The Harvard study reported these other findings:

- U. S./Soviet arms control agreements have been reached only when neither side had an appreciable advantage, i. e., only when rough parity exists in the relevant forces.
- Overall parity is not enough, although precise equality is not required, either. Where no acceptable tradeoff exists in key elements of the strategic balance, inferiority cannot be formalized by agreement and can be rectified only by unilateral effort.
- Technological advance is not by itself an insurmountable obstacle to arms control, but the difficulty of achieving an agreement is compounded if either party has tested a weapon or invested heavily in it. Thus the ABM treaty was achieved when both sides concluded that competition would prove costly, possibly destabilizing and, in the near-term at least, technologically futile. In contrast, the U. S. lead in MIRVs during SALT 1 resulted in neither side offering a serious constraint proposal. This was partly because "MIRVs are technically sweet: they offer a cost-effective means for increasing target coverage and for overwhelming traditional kinds of ABM systems."
- Unilateral U. S. restraint does not induce reciprocal Soviet behavior. Slow U. S. ABM development in the 1960s had no appreciable effect on the pace of Soviet efforts. Unilateral U. S. restraints to cap the number of land-based and submarine-based ballistic missile launchers in what became the U. S. totals for SALT 1 did not prompt the Soviets to curtail their own efforts once they attained numerical equality.
- In some instances, unilateral U. S. restraint allows the Soviets to catch up and if this leads to parity, there may be a consequent increase in the Soviet, and perhaps American, desire for a formal agreement.
- U. S./Soviet relations do not improve as a result of signing arms control accords. Their rivalry continued unabated in the wake of all the agreements surveyed.
- Agreements do not foster American public complacency about the Soviet threat because in signing such pacts, U. S. political leaders of necessity must pledge continued military investment if they are to gain both public support and the backing of the Joint Chiefs of Staff.
- Historically the Joint Chiefs of Staff tend to favor arms control because it helps define the boundaries of the Soviet threat and introduces an element of predictability, which in turn assists U. S. force planning. Nevertheless they are wary of constraints on emerging U. S. programs and often bargain their support for arms control for a White House commitment to force modernization. ☐

To Mars

(Carl Sagan, Director of the Laboratory for Planetary Studies at Cornell University, Ithaca, N. Y., and President of The Planetary Society in Pasadena, Calif., is a long-time proponent of planetary space programs. Following are his views on how a commitment to a Mars exploration program would reenergize the U. S. space program.—Ed.)

There was a time when the American space program was the proudest in the world. As the National Aeronautics and Space Administration landed men on the Moon and launched robot emissaries to every known planet except Pluto, people all over the world—even those with grave reservations about other aspects of U. S. policy—confessed their admiration. It was not just that our technology had proved powerful beyond the pretense of myth and legend, but, more important, that it was so obviously a force for human good. We humans were exploring other worlds. The United States was leading the way, as we said explicitly, "in peace for all Mankind."

Today, symbolized and encapsulated by the Challenger disaster, NASA is in shambles. It is struggling to lift payloads that 10 or 20 years ago were routine. First-rate scientists and engineers are trickling away, and the brightest graduate students envision their futures elsewhere. American firms negotiate for French or Chinese boosters to lift commercial payloads. Through mismanagement, timidity of vision, declining funding, presidential neglect and the absence of an overarching goal, NASA has astonishingly become the butt of ridicule.

Undefined Goals

Since the end of the Apollo era, NASA has been given nothing approaching a coherent, generally understood goal, and this surely represents a failure of presidential and congressional leadership. After dozens of such launches in the preceding 18 years, since 1978 not a single American spacecraft, manned or unmanned, has been launched to the Moon or the planets. Military expenditures in space now far exceed NASA's.

The Strategic Defense Initiative has gobbled up NASA as the embodiment of the U. S. space program. There is a danger that these trends could accelerate the fall from grace of the agencies involved and also erode the support for high technology by people here and abroad—already made uneasy because of nuclear weapons, Challenger, Chernobyl and the Sandoz pollution of the Rhine.

Many competent observers believe SDI cannot, even in decades, defend the civilian population; that it is vulnerable to ready Soviet countermeasures, is ruinously expensive and may increase, not decrease, the likelihood of nuclear war. After the present administration leaves office, SDI is likely to dwindle to hard-target terminal defense or less. What will the U. S. aerospace industry do then?

What if sometime in the next few years a general strategic settlement with the Soviet Union is achieved—as is clearly longed for by people all over the world? What if the level of military procurement—nuclear weapons certainly and perhaps conventional weapons too—begins to decline? America urgently needs a technological goal appropriate to carry us into the Third Millennium with a scope and depth that recaptures both domestic and worldwide admiration.

Fortunately such a goal is within reach. It is now feasible to initiate a systematic program of exploration and discovery on the planet Mars—beginning with robot roving vehicles and return sample missions and culminating in the first human footfalls on another planet.

The cost would be much less than SDI deployment; no greater than a major strategic weapons system, and if shared by two or more nations, still less. No fundamental technological advances seem to be required, and the technological step from today to humans on Mars appears to be easier than the step from President Kennedy's announcement of the Apollo program to the first landing of humans on the Moon.

Exploration Justified

The prospect of human exploration of Mars is ecumenical—remarkable for the diversity of opinion it embraces. It is justified for a variety of reasons:

- As providing a focus and sense of purpose to a dispirited NASA, and on an appropriate timescale.
- As a human adventure of high order, able to excite and inspire the most promising young people.
- As a potential scientific bonanza—for example, on climatic change, on the search for present or past life, on the understanding of enigmatic Martian landforms and on the application of new knowledge to our own planet.
- As a means, through robotic precursor and support missions to Mars and elsewhere, of reviving a moribund U. S. planetary program.
- As giving a crisp and unambiguous purpose to the U. S. space station—needed for in-orbit assembly of the interplanetary transfer vehicle or vehicles.
- As an aperture to enhanced national prestige and technological development.
- As a realistic and possibly unique opportunity for the United States and the Soviet Union to work together in the spotlight of world public opinion, and with other nations, on behalf of the human species.
- As a model and stimulant for mutually advantageous U. S./Soviet cooperation here on Earth.
- As a means for economic reconversion of the aerospace industry if and when massive reductions in strategic weapons—long promised by the United States and the Soviet Union—are implemented.
- As a worthy continuation of the traditional application of the military virtues of organization and valor to great expeditions of discovery.
- Or simply as the obvious response to a deeply felt perception of the future calling.

Once humans have safely landed on Mars, they can be expected to investigate its eventual habitability, with the long-term objective of establishing humanity as a multi-planet species. The United States, with other nations, should declare the Mars goal, and initiate the early steps in its implementation.

New Defense Space Policy Supports Manned Flight Role

By Craig Covault

Washington—Defense Dept. is completing a new U. S. military space policy expected to accelerate development of technology to protect Strategic Defense Initiative spacecraft from Soviet attack and provide strong Pentagon support for future manned military space operations.

For more than 20 years, the Defense Dept. has been unable to define a strong operational role for U. S. military astronauts in orbit. Final drafts of the new Defense Space Policy, however, call for a more thorough examination of future manned military operations.

The Defense Dept. is taking this position in part because of impressive Soviet manned military demonstrations on the Salyut 7 space station, which have been monitored by U. S. intelligence agencies, a senior U. S. space official said.

The Defense Space Policy also will endorse a move toward development of a new unmanned heavy-lift booster, such as the Jarvis or similar concepts.

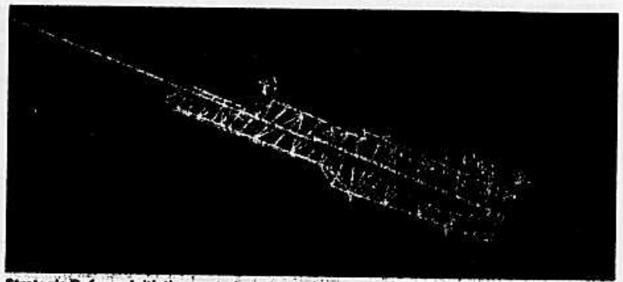
The policy will influence billions of dollars of defense space development across varied mission areas into the 21st century. Final reviews of the draft policy were to begin Dec. 5 before the plan is submitted to Defense Secretary Caspar W. Weinberger for his approval.

Reagan Administration officials believe formation of the new policy demonstrates that they are reacting quickly to deficiencies in U. S. space capabilities. As further evidence, officials point to a new White House National Security Council initiative to revise the earlier National Space Policy and National Space Strategy.

The new military space policy has been completed by a Defense Dept. working group including the Air Force, Navy, Army, Joint Chiefs of Staff and SDI Organization. It has been circulated among senior space managers in these services for final comment. The working group that formulated the policy is headed by Charles W. Cook, deputy assistant secretary of the Air Force for Space Plans and Policy.

The new plan will replace a policy formed in 1982, now outdated after significant changes in the U. S. space program. An increasing Soviet capability, the Strategic Defense Initiative, the shuttle Challenger accident and the move to a fleet capable of both manned and unmanned flight are all significant factors in the new policy.

A key theme throughout the draft policy is how U. S. military space systems are becoming a more integrated part of U. S. military operations. As such, those systems need to be as survivable as their ground-based counterparts—and more so if there are no other systems providing complementary support. This aspect is particularly important in reference to SDI.



Strategic Defense Initiative neutral particle beam spacecraft is shown firing in the McDonnell Douglas concept at left, illustrating the type of projected space operations covered under the new Defense Dept. space policy. The device would be launched folded in the shuttle cargo bay and after deployment would unfold to 100-120 ft. long. McDonnell Douglas and Lockheed are competing for the development that would demonstrate how SDI systems could discriminate between Soviet warheads and decoys in space.

Since SDI spacecraft would be extremely critical systems during war, the policy stresses the importance of beginning development efforts to make the systems survivable if attacked by the Soviets. Future SDI spacecraft, as well as existing military satellites, require protection against attack by Soviet ground-based laser systems, radio interference and kinetic attack systems.

In the areas of space-based intelligence and surveillance, the new Defense Space Policy is expected to call for an expansion of capability that could be used by commanders in the field, an area stressed by U. S. Army space officials. Army and Marine Corps commanders are interested, for example, in satellite imagery of the local and regional tactical situation.

The policy will call for a broadening of U. S. reconnaissance technologies—to new radar systems, for example—and proliferation of reconnaissance satellites.

The policy will strongly endorse a move toward unmanned launch operations for most U. S. military space cargo and eventual development of a new heavy-lift unmanned booster. It further endorses modification of existing critical military spacecraft and development of future satellites to allow them to be launched on either the shuttle or unmanned boosters. Dual compatibility modifications already are being added to critical payloads such as imaging reconnaissance spacecraft, electronic intelligence vehicles and missile early warning satellites.

Drafts of the Defense Space Policy also recognize that the shuttle, space station and follow-on vehicles such as Shuttle-2 and the aerospace plane are opening new manned military opportunities in areas such as ocean surveillance, strategic reconnaissance, command and control and the servicing of spacecraft in orbit.

Cancellation of the USAF Manned Orbiting Laboratory military reconnaissance program in the late 1960s and the inability of USAF Air Staff Studies in 1978 to define the utility of military space crews occurred because of limited flight experience in military space areas.

Since then, however, shuttle astronaut experience in ocean observations, satellite deployment and repair and extensive Soviet manned military space demonstrations have changed the basis from which future operations can be assessed.

One USAF officer noted that the Soviets already have demonstrated significant manned ocean surveillance, command and control and military technology efforts, including those characterized as Soviet SDI technology demonstrations in space. Observing such activity has been an extremely valuable, low-cost method of demonstrating to U. S. planners what military astronauts could accomplish.

The potential for satellite servicing is already leading to an increased role for NASA in future military space operations.

NASA and Defense Dept. recently signed a joint agreement on development of in-orbit satellite maintenance and repair capabilities. The agreement has the potential of making the civil space agency an inherent part of developing or implementing the servicing of existing military payloads, such as reconnaissance satellites, and future payloads, such as SDI spacecraft.

A joint NASA/Defense/SDI team is conducting an extensive study of the type of spacecraft refueling and servicing that will be possible, both from manned vehicles such as shuttle and with unmanned robotic spacecraft. During the next several months, specific servicing demonstration missions that could be done in the early to mid-1990s will be recommended, with the emphasis on doing a mission much more operationally oriented than previous in-orbit efforts, such as the Solar Max satellite refurbishment.

Such capabilities will be essential for the operational deployment of large, long-term SDI spacecraft, and could save costs on smaller military spacecraft, such as reconnaissance satellites, for which orbital refueling could provide significant operational benefits. Since 1971, Central Intelligence Agency and USAF space reconnaissance operations have used about 25 large imaging reconnaissance satellites with a total value of several billion dollars. With orbital refueling and film replenishment, fewer spacecraft could have flown extended missions.

Joint Effort

Lockheed and TRW both have contracts expected to total more than $1.5 million to study spacecraft assembly maintenance and servicing under the joint NASA/Defense/SDI effort. The two military organizations are each contributing 40% of the funding, while NASA is contributing 20%. The effort has been under way since March and is expected to be extended until October, 1987.

Although the study is not part of the new Defense Space Policy, it is in direct support of a key element of the policy, which states that when block changes are made in existing military spacecraft design or new spacecraft are proposed, orbital servicing should be considered to reduce costs and increase mission operations.

The contractors first developed mission models to help indicate which planned and future spacecraft had commonality for various servicing factors. Between 6 and 10 design reference missions were then derived by each contractor to help narrow common requirements. Among the demonstration missions that could be proposed in 1987 is development of a space tanker system for use in the space shuttle. This could be used in the early 1990s to refuel a demonstration spacecraft. The tanker design could then be adapted by NASA, Defense or SDI as needed to refuel operational spacecraft, such as Earth resources satellites and military reconnaissance vehicles.

A robotic servicing demonstration of a free-flying satellite could be recommended in order to make use of a robotic system before it is integrated with the station. ☐

Ten ESA Member Nations Join Hermes Spaceplane Program

Bordeaux, France—Ten countries have made formal commitments to participate in the $35-million preparatory development effort for Europe's Hermes spaceplane, which is expected to enter service in the mid 1990s.

Several other countries are considering joining the program, which will continue through next summer to refine the design of Hermes and its systems.

The Hermes was conceived by the French CNES national space agency, and the vehicle will be orbited by the Ariane 5 heavy-lift launcher. The preparatory effort was approved in October as a multinational project within the framework of the European Space Agency (AW&ST Oct. 27, p. 22).

The ESA member states that have formally committed to participation in Hermes' preparatory program are Austria, Belgium, Denmark, France, Ireland, Italy, Spain, Sweden, Switzerland and West Germany. Philippe Couillard, CNES Hermes program director, said England, Holland, and Canada also are expected to join the spaceplane's preparatory program in the near future.

Hermes will be capable of performing a number of missions, including servicing of space stations or orbital platforms and autonomous flights for a variety of science and observation requirements. Current plans call for two Hermes vehicles to be built. France's Aerospatiale is industrial prime contractor for Hermes, and Dassault-Breguet is in charge of the spacecraft's aerodynamics/reentry aspects.

A number of major Hermes program elements were outlined at the Technospace exhibition here.

- France has contacted the Soviet Union to discuss the technical aspects necessary to make Hermes compatible with the Soviet's Mir orbital space station. This would allow Hermes to dock with Mir. The U. S. also has shown interest in working with Europe to have Hermes compatible with the U. S.-managed international space station.
- A commission is being established to define safety/rescue aspects of Hermes and its Ariane 5 launcher.
- France's Aerospatiale has been awarded a $2.3-million contract to modify its Bordeaux-area thermal test facility to make it capable of performing high-temperature evaluations of thermal protection materials to be used on Hermes. The CNES contract is part of a coordinated European plan to develop the key test facilities it lacks to support the development of Hermes.
- Dassault-Breguet has proposed that its Falcon 900 trijet business aircraft be modified for use as a Hermes approach and landing trainer aircraft. The concept is based on the National Aeronautics and Space Administration's use of a Gulfstream business jet to train shuttle orbiter crews for the final approach and touchdown phase. A scale model of the Falcon 900 pilot training aircraft was shown on Dassault-Breguet's exhibit stand at Technospace.
- A commission has been established to study a multi-million dollar proposal from Dassault-Breguet to build two 1/[illegible]-scale Hermes models to evaluate the spacecraft during reentry. The unmanned 1/[illegible]-scale Hermes, designated Maia, would be launched by an Ariane 4 or the U. S. space shuttle for a controlled reentry.

Couillard said the major Hermes preparatory program contracts have been awarded to European contractors for definition of the spacecraft's major systems. Selected contractors include Messerschmitt-Boelkow-Blohm for the propulsion system; Dassault-Breguet, in association with Societe Europeenne de Propulsion, for Hermes' thermal protection; Dornier for environmental control/life support; Aeritalia for the thermal control; Fokker for the manipulator arm, and Matra for Hermes' onboard data management. ☐

NASA Emphasis on Shuttle, Station To Continue Under New Goals

By Theresa M. Foley

Washington—National Aeronautics and Space Administration this week will issue revised internal goals that will continue the space program's heavy emphasis on operational programs such as the space shuttle and space station, and also will begin to reorient NASA's mission more toward science and exploration.

Administrator James C. Fletcher is expected to adopt three primary goals, directing NASA to work toward expanding human presence beyond Earth, strengthening aeronautics research, and increasing scientific knowledge of the Earth, the solar system and the universe. Two supporting goals call for the development of new technology for space transportation systems and other civilian purposes.

Noel Hinners, chairman of the executive committee of NASA's Strategic Planning Council, which developed the goals, said they will provide top-level guidance to senior managers for daily decision making and budget planning. NASA's previous goals were based on a very short-term viewpoint and did not help managers do "a good job tying individual programs together," Hinners said.

Returning the shuttle safely to flight status will be among the new goals. They are more general and substantially different than those set in 1983, which called for making the shuttle "fully operational and cost effective in providing routine access to space," and establishing a permanent presence in space. The new goals will omit objectives set in 1983 that called for NASA to provide commercial launch services, and will place less emphasis on expanding opportunities for private sector investment in space.

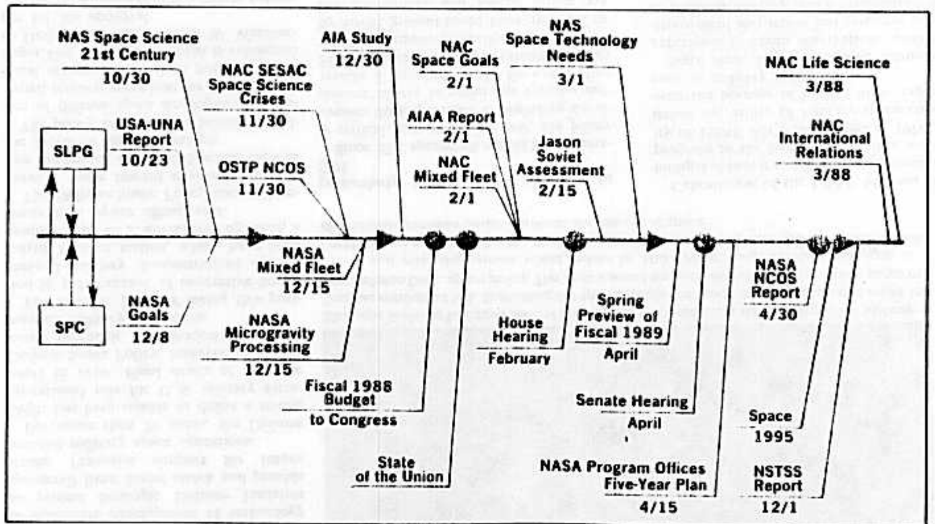
Criticized Focus

Since the Challenger accident, members of Congress, scientists and others have criticized NASA for focusing its goals on operations, instead of science and exploration.

Critics believe pressure to achieve routine shuttle operations, called for in the 1983 goals, was a factor underlying the Challenger accident. Hinners said achieving the proper balance of operational and research programs remains a chief concern of top NASA managers. The new goals are a "public reiteration of NASA's basic mission," Hinners said, and will be further explained in objectives laying out specific program details and priorities that will be issued next summer.

NASA officials have begun to devise a 10-year strategic plan that will provide direction for the space program and respond to concerns that the U. S. has lost its leadership in space.

The White House response to the National Commission on Space report, which is being written by the Office of Science and Technology Policy, is expected to play a key role in influencing the strategic plan. The commission, chaired by Thomas Paine, recommended civilian space goals for the 21st century, including manned exploration of Mars and establishment of a manned lunar base.



More than a dozen groups will contribute to the NASA 10-year strategic planning effort, headed by astronaut Sally Ride. The chart shows external advisory groups above the timeline, and advisory groups inside NASA and other Administration branches below. Other events that will be influenced by long-range planning also are included, such as submitting the Fiscal 1988 budget to Congress. Ride will use recommendations from the above sources in forming the long-range plan, called Space 1995. Groups participating in the effort include the NASA Space Leadership Planning Group (SLPG); NASA Strategic Planning Council (SPC); United Nations Assn. of the USA (USA-UNA); White House Office of Science and Technology Policy (OSTP); National Commission on Space (NCOS); NASA Advisory Council (NAC); Space and Earth Sciences Advisory Committee (SESAC); Aerospace Industries Assn. (AIA); American Institute of Aeronautics and Astronautics (AIAA); National Space Transportation Systems Study (NSTSS), and National Academy of Sciences (NAS).

The White House response to the Paine commission was scheduled to be forwarded to the Senior Interagency Group for Space for review several months ago, but is far behind schedule. One senior space manager familiar with the review told AVIATION WEEK & SPACE TECHNOLOGY that a preliminary draft of the White House review was very weak and lacked "direction and vision."

The White House review and new NASA goals are among more than a dozen reports that will be considered in formulating Space 1995, the long-range strategic plan. It will be developed by a small group at NASA headquarters, headed by Fletcher's special assistant for strategic planning, astronaut Sally Ride. Space 1995 will be completed in April or May, 1987 (AW&ST Sept. 15, p. 77).

Directing Attention

Alan Ladwig, an assistant to Ride, said Space 1995 will focus attention on where the nation's space program should be directed beyond 1994.

The Space 1995 report, Ladwig said, "will focus on revitalizing the U. S. space program and ensuring future U. S. leadership."

The strategic plan will include diverse input:

- Reports from two NASA teams studying adoption of a mixed-fleet launch program and reassessment of microgravity processing efforts will be provided to Fletcher Dec. 15. Astronaut Bonnie Dunbar, who is leading the microgravity processing assessment, will file an interim report next week. Darrell Branscome, an official in the space flight directorate, heads the mixed fleet study and will make a final report next week.
- An internal NASA Space Leadership Planning Group, headed by NASA advanced programs director Ivan Bekey, is formulating NASA's response to the National Commission on Space report. This group will report to Congress in the spring, but will circulate recommendations to other groups involved in strategic planning efforts before then.
- Aerospace Industries Assn. will review recommendations made by Bekey's group and provide NASA with an industry perspective on future activities.
- The National Academy of Sciences Space Science Board has written a report on space science in the 21st century, entitled Major Directions (AW&ST Nov. 3, p. 38). It urges the U. S. to adopt as its main objective for the civilian space program the goal of advancing the knowledge of science and its applications for human welfare.
- The United Nations Assn. of U. S. A. report on international space cooperation, released in October, recommended a new space agreement between the U. S. and the Soviet Union (AW&ST Nov. 3, p. 40).
- The NASA Advisory Council has two reviews under way to provide advice on use of a mixed fleet and space goals, both of which will be completed in February.
- Two more NASA Advisory Council reviews, on international relations and life sciences, will not be completed until later in 1987 and 1988, but Ride is expected to include some input from these groups in her overall recommendations.
- NASA Advisory Council Chairman Daniel Fink is heading a task force that will made a net assessment in 1987 of space capabilities and future plans of all significant space powers, and will issue a classified report with an unclassified annex.
- The Space and Earth Sciences Advisory Committee, which reports to the NASA Advisory Council, last month issued its report, Crisis in Space and Earth Science (AW&ST Nov. 17, p. 86). SESAC called into question U. S. preeminence in space and recommended several changes to NASA's space science program, including the reintroduction of expendable launchers for science missions.
- Mitre Corp. and a group of university scientists are assessing Soviet space capabilities and will provide a classified interim report to Fletcher by Feb. 15.
- A committee of the National Academy of Sciences' Aeronautics and Space Engineering Board will report in March on future space technology needs to accomplish civilian space objectives over the next 30 years.
- American Institute of Aeronautics and Astronautics will vote in December on adoption of a technical assessment declaring that U. S. space leadership is in jeopardy. The assessment calls for increased funding and a reassessment of the space policymaking apparatus, and concludes that U. S. space leadership can be restored if certain steps are taken. ☐

Congress Still Questioning Space Station Plans

Washington—NASA is working to release space station hardware development requests for proposals by Jan. 15, but this goal is threatened by congressional questions about international cooperation and payload funding, a congressional staff member said last week.

NASA released draft RFPs in late November, but $150 million in Fiscal 1987 funding to pay for the contracts has been placed on hold by Congress until NASA responds to congressional concerns, which must be done before station contracting can proceed.

Life Sciences Concerns

House Appropriations Committee members are worried that life sciences requirements may not adequately be provided for in the current station plan. The European Space Agency module will contain some life sciences equipment, but the Europeans will not include instruments that are disruptive to materials processing work.

Another unresolved issue is the location of an animal holding facility, which none of the international partners wants to include in its pressurized module, although life scientists consider it essential to the station. One option is to separately fund the animal facility and locate it in another module or in one of the station's expanded resource nodes.

The committee also is concerned over the lack of identified station payload funding in NASA's space science budget. Scientists have called for separate line-item funding for payloads, but NASA officials disagree that a separate payload budget is needed (AW&ST Nov. 24, p. 18). ☐

NASA Assessing Soviet Space Program

Washington—NASA has begun a classified assessment of the Soviet space program that will provide the agency with a technical analysis of Soviet launch vehicles, manned space flight and space science activities.

The assessment, a reflection of the increased attention that is being given in the U. S. to competition from the Soviets and other countries for space leadership, will be performed by a group of university professors and Mitre Corp. An interim report by the team, known as the Jason group, is scheduled to be delivered to NASA Administrator James C. Fletcher by Feb. 15.

The award of a Soviet assessment contract reflects increased pressure on NASA to recognize Soviet competitiveness in space. It also marks a change from previous NASA administrations, which have avoided making formal analysis of the Soviet space program. Most U. S. assessments of Soviet space capabilities to date have been done by the intelligence agencies, the Congressional Research Service, consulting firms or independent analysts.

A second classified report on Soviet, Chinese and other foreign space programs, including that of the European Space Agency, will be done by the NASA Advisory Council net assessment task force, headed by council Chairman Daniel Fink. A classified report and unclassified annex by the Fink task force will be completed in summer, 1987, and interim reports are planned for January and April.

Europeans Choose Modifications To Enable Ariane to Resume Service

Bordeaux, France—Europe has selected modifications for Ariane's third stage that should allow the commercial launcher to resume service early next year. A date for the startup of launches has not been fixed, but it probably will be several weeks later than the last tentative target of February.

The changes to Ariane's third-stage igniter were developed following the V18 launch failure last May, and were approved Nov. 28 by the European Space Agency, Arianespace and the French CNES national space agency.

Arianespace Chairman Frederic d'Allest said the next Ariane mission is expected in March or April, but an exact date will not be fixed until a detailed qualification and acceptance procedure is completed.

Arianespace is the commercial management/marketing organization for the Ariane program, which was organized under direction of the European Space Agency. CNES is prime contractor for Ariane.

"We do not think we will be able to meet our initial tentative target of next February for the resumption of Ariane missions, but we feel the delay beyond this target can be limited to a few weeks," d'Allest said at the Technospace exhibition here last week.

Program officials pointed out that the February target—first listed in the tentative manifest issued by Arianespace last September—was contingent on the completion of test firings and a review of the test results by the V18 accident board (AW&ST Sept. 8, p. 37).

Ignition Tests

Twenty-three ignition tests were carried out under simulated altitude conditions in Vernon, France, by Societe Europeenne de Propulsion (SEP), Ariane propulsion system prime contractor (AW&ST Oct. 27, p. 53).

Modifications developed by SEP and approved for incorporation in Ariane's third stage are:

- Use of an igniter three times more powerful than the original design.
- An increase in the igniter's gas temperature.
- Selection of a twin-jet igniter design that will provide a better flame pattern than the single-jet configuration used on the previous Ariane launchers. The jets are oriented 45 deg. from the center axis of the igniter's injector arm.

SEP Chairman Jean Sollier said the new igniter design provides the additional margins necessary to assure a successful ignition under varying temperature and propellant flow conditions. He said the original single-jet igniter functioned as planned during the V18 flight, but was unable to ignite the engine chamber under the conditions that existed at the critical moment in the ignition sequence. The Ariane third-stage igniter is produced by SEP's Bordeaux/Le Haillan facility.

New igniter for Ariane's third stage will have a twin flame pattern, operate with a higher gas temperature and be about three times more powerful than the original design. One of the two flame holes is partly visible on the right side of the cone-shaped end of the injector arm at top. The cylinder-shaped main body contains the pyrotechnic charge. At its base are two initiators and a pressure sensor.

Modifications to Ariane's third stage followed the guidelines drawn up by a multinational accident board that was established to investigate the V18 launch failure.

Fourteen recommendations were made by the board earlier this year concerning steps that should be taken to improve Ariane's operation and reliability (AW&ST July 7, p. 22).

"The board now estimates that about 75% of the work being performed in response to its 14 recommendations has been completed," d'Allest said. "We have much work ahead of us before we can give a go-ahead to the V19 mission."

D'Allest said the main activity now is focused on four themes: qualify the new igniter design, demonstrate the new igniter's effectiveness throughout all possible flight conditions, validate that the new ignition system can perform in several engines and justify that the wider margins deemed necessary for operation of the third-stage ignition system are sufficiently large to allow an ignition, even if the engine chamber conditions of the V18 mission were repeated.

In addition to specific fixes resulting from the V18 mission, Europe has decided to pursue a multiyear program designed to improve the overall reliability of the third stage, d'Allest said. Three of the four failures suffered by Ariane since its first launch in 1979 were due to problems in the third stage.

"We plan to use this third stage on the various Ariane versions for more than 20 years. We, therefore, have decided to accept a recommendation by SEP for a multiyear program to 'harden' the third-stage engine to give it the reliability we need over the long term," d'Allest said. "The 2-3 year effort will be recommended to ESA for its approval."

European space officials estimate that the cost of Ariane modifications resulting from the V18 failure, combined with the multiyear "hardening" program, will total 700 million-1 billion French francs ($107-156 million). The money will be paid by ESA in its role as the Ariane development authority. The space agency has begun discussing how the cost will be handled by its member nations, ESA Director General Reimar Luest said.

The delay in Ariane launches will cost Arianespace an additional 500 million French francs (about $77 million), according to current estimates. Arianespace's insurance will cover about 100 million francs, d'Allest said.

"However, we expect Arianespace's 1986 cash flow will be at about the same level or slightly better than last year's total of 200 million francs, and we should show a slight profit, which I think will be equal to or just above that of 1985," he said.

Arianespace's tentative manifest issued last September had seven launches in 1987, but this has been revised to six.

The exact launch order for customer payloads in 1987 is being reviewed. Intelsat—whose communications satellite was destroyed in the V18 failure—is requesting priority in the scheduling of its next spacecraft to be launched by Ariane, d'Allest said. ☐

Titan 34D Solid Rocket Motor Segments Near Launch Approval

By Bruce A. Smith

Los Angeles—The Titan recovery program is passing a milestone with clearance for launch of the first full set of USAF/Martin Marietta Titan 34D solid rocket motor segments since the T34D launch failure at Vandenberg AFB, Calif., eight months ago.

Confidence is high within the recovery program in the capability of an array of new test equipment to detect flaws within the motors that could lead to the type of failure that occurred Apr. 18. An Air Force official said there has been a "quantum leap forward" in the quality of data obtained through nondestructive testing of the 10-ft.-wide motor segments during the past six months.

Most probable cause of the Apr. 18 launch failure was a weak bond between the insulation and the inside of the motor case. Most of the nondestructive techniques now in place were not used prior to the April failure.

The motor segments are expected to be cleared at Vandenberg AFB, Calif., late this month or early next month through use of new inspection techniques that have been added as a result of the Apr. 18 failure.

The process of clearing the two-stage Titan core vehicle for launch is 95% complete. This is part of the reassessment of the Titan system ordered after the April accident. Another Titan failed during launch from Vandenberg 16 months ago. The T34D reassessment, which began about one month after the April accident, is focusing on the solid propellant motors but is covering essentially all major vehicle systems—including the liquid propellant engines and guidance systems.

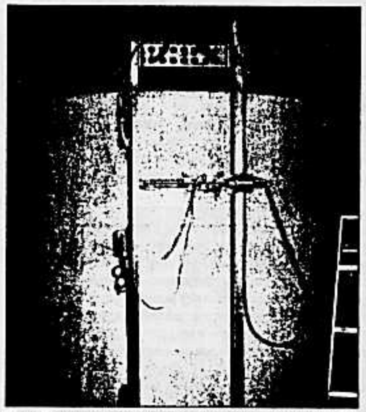
Clearance of the first set of motor segments brings the next Titan launch a step closer, although project officials want to obtain data from two other system test programs before the next T34D mission. These test programs are:

- Firing of a two-segment motor at a modified Rocket Propulsion Laboratory (RPL) test stand at Edwards AFB, Calif. The first of two planned firings of "short stack" motors is scheduled for February.
- Results of surveillance tests on motor aging being conducted at Hill AFB, Utah. The segment being evaluated is the oldest segment currently in the Titan inventory. Initial aging results were expected to be available this week and final results by March.

Motor segment inspections at Vandenberg and Cape Canaveral AFS, Fla., include ultrasonic, X-ray, thermography, compression and laser-enhanced video tests. To expedite qualification of a set of flight motors, the segments at Vandenberg will be run through the series of tests as long as they pass. If a segment fails a test, it is set aside and replaced by another segment until a full motor set is qualified.

Similar nondestructive testing has begun at Cape Canaveral AFS by the Air Force, which plans to continue automated testing of Titan solid motor segments at both coasts. Each full motor segment is 10 ft. high and 10 ft. in diameter.

To date, nondestructive test data have been of high quality, according to project officials, with good resolution in detecting defects. For example, an aft closure was rejected this month when an X-ray test found propellant voids 0.3 in. in size. Segment testing at Vandenberg prior to the April Titan accident involved little more than visual and feeler gauge inspection of upper and lower insulation edges, as well as tap tests.



New Titan motor ultrasonic test at Vandenberg AFB, Calif., is designed to detect debonds between the motor case and insulation. Most probable cause of the Apr. 18 Titan failure was a weak case/insulation bond.

Prior to the failure in April, there had been no anomalies during launch with the Titan motors, according to the Air Force. A total of 136 Titans have been launched to date with a 94% success rate. Prior to August, 1985, there were seven successful launches of the Titan 34D, which is designed to place a payload of 27,600 lb. into a 100-naut.-mi. polar orbit from Vandenberg.

There were five sets of booster motors in the inventory and one set in production when the April launch failure occurred. The set in production and one completed set are being rebuilt and other segments are being used for testing. The motors in the inventory as of last April that have been retained were produced approximately five years ago.

The short-stack motor tests at Edwards are intended primarily to study how the joint between motor segments functions during ignition, as well as evaluating launch temperature limitations. The test stand, previously used for Saturn F-1 engines, will allow nozzle-down testing and has been modified to accommodate a full 5.5-segment Titan 34D motor. There are no plans currently to test a complete T34D motor on the facility, which is designated test stand 1-C.

Primary reason for selecting the RPL for the firings was to avoid interfering with tests of the seven-segment Titan 4 motor at facilities operated by the Chemical Systems Div. of United Technologies. The Titan 4 program is on schedule.

Seven-segment motors for the Titan 4 originally were developed for the manned orbiting laboratory. Four of the large motors were fired as part of the laboratory development program, with the remaining two scheduled firings yet to be completed.

The Titan 4 with the inertial upper stage (IUS) is scheduled to be available for launch during the fourth quarter of 1988, while a Titan 4 with no upper stage is expected during the first quarter of 1989. The planned Centaur upper stage Titan 4 is scheduled for initial operational capability during the first quarter of 1990.

Martin Marietta officials said they are tracking the Titan 34D recovery program and incorporating changes in the Titan 4 when necessary. Martin tailored initial development around use of the IUS, delaying start of detailed Centaur development until recently. Critical design review for the IUS/Titan 4 was completed in October.

The seven-segment motors are scheduled to be test fired this summer, and the first set of core vehicle tanks will be shipped from Denver to Cape Canaveral early next year. The first large fairing is scheduled to arrive at Martin Marietta from McDonnell Douglas early next year for structural testing. ☐

Boeing Offers to Underwrite New Jarvis Development Concept

By Edward H. Kolcum

Kennedy Space Center—Boeing Aerospace Co. has told NASA and the Air Force it is willing to commit its own money to develop the Jarvis heavy-lift vehicle into a system able to put more payload into orbit than any other launcher and with the potential of substantially reducing the time and cost of making the space station operational.

Boeing estimates total development costs for the unmanned Jarvis system at $1 billion, to be shared by Boeing and Hughes Aircraft Co., with Boeing paying the larger portion. Boeing said that, at this point, it is still gathering data on which to base a corporate decision on whether to invest in the project.

The company forecasts an annual requirement for at least six Jarvis-class launchers to meet the needs of the Strategic Defense Initiative Organization, the Defense Dept., NASA and commercial customers. Boeing maintains that five Jarvis flights committed to space station missions would:

- Reduce the number of shuttle flights for space station assembly from 17 to five.
- Cut space station assembly costs by $700 million.
- Permit station completion two years earlier than if shuttle-only flights are used.
- Facilitate permanent manning a year sooner than planned.

The Air Force is expected to issue a requirement for a heavy-lift vehicle in March or April, which Boeing will respond to with the Jarvis system. Boeing said that, assuming a go-ahead within the next three months, it will be able to conduct its first Jarvis launch in 1990 using shuttle processing, launch and flight hardware.

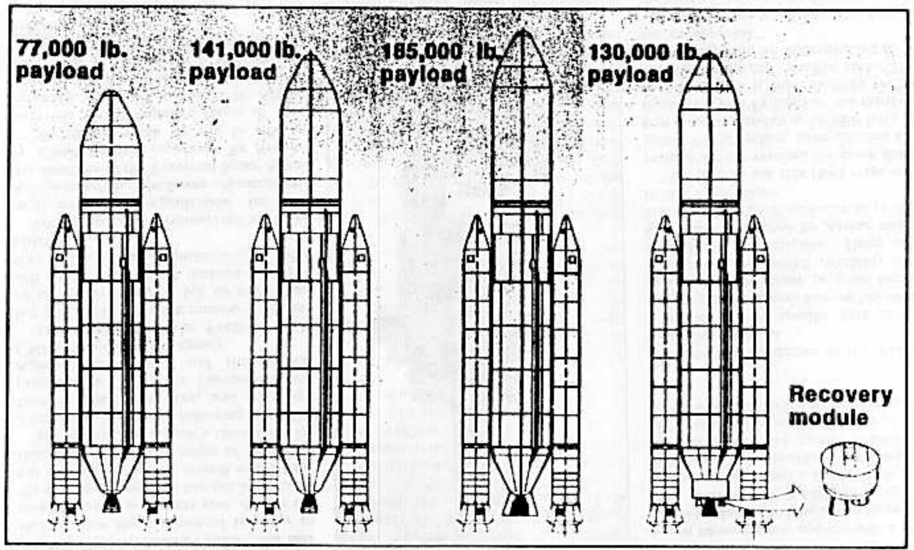
Independent Studies

Boeing has said that Jarvis is not competing with the Titan 4 or space shuttle launchers and that the company is not seeking funding or subsidies from NASA. Rather, Boeing is asking for NASA's cooperation in determining whether a market for the Jarvis exists. Four independent studies have shown there is such a market, the company said, adding: "We want to be brought into the launcher family as a cooperating member." The Boeing presentations to NASA and the Air Force represent a significant shift in roles in the Jarvis project.

Until early November, Hughes Aircraft Co. had been the lead industrial company and the project was known as the Hughes/Boeing Jarvis. Boeing has now taken over responsibilities estimated at 70-80% of the hardware and value of the program, and company leaders are expressing a willingness to assume that portion of the development risk. Boeing wants NASA to provide help in assessing the market and to enter into understandings on such program elements as facilities use and technical cooperation.

Jarvis launcher responsibilities now are divided this way:

- **Boeing**—Core stage and solid boosters, fairing, vehicle integration and launch, launch site activation and logistics. In addition to boosters, the core stage consists of shuttle main engines and external tank.
- **Hughes**—Mission planning and control, payload integration and Jarvis transfer platform.



Baseline Jarvis heavy-lift vehicle at left could be adapted to three other launchers as shown. All vehicles would have two shuttle solid rocket boosters. The baseline version would have a single shuttle main engine; the second, two engines, and the third, three. The vehicle on the right would have two shuttle main engines that would be recoverable along with reusable avionics. The performance figures indicate payload weight into a 220-naut.-mi. orbit at 28.5 deg. inclination, which is nominal for a Kennedy Space Center launch.

The Jarvis vehicle underwent a radical design change in September, and the concept is now based largely on space shuttle elements (AW&ST Oct. 6, p. 24). The original design was based on Saturn propulsion and was an entry in the Air Force medium launch vehicle proposal. With the current shuttle-based design, Jarvis was eliminated from the MLV competition because it was considered too powerful for the MLV role, which is keyed to launching the Navstar satellite.

Boeing said it is still gathering data prior to making a corporate commitment to proceed with Jarvis. The company also needs an agreement with the government for reimbursed use of facilities and services. And, just as important, it needs a kickoff customer.

Boeing believes Jarvis will be most cost-effective if existing processing and launch facilities at Kennedy Space Center are used. The company consequently began its marketing effort with what it identifies as a "commercial offering" here. The objectives are to develop an operational concept for Kennedy that is satisfactory to NASA, to develop a business relationship for sharing and possibly modifying some Kennedy facilities, and to collaborate on a commercialization agreement.

Boeing has obtained NASA permission to conduct working meetings with Kennedy technical and business representatives to assess the Jarvis concept and to conduct a summary briefing on the concept later this month.

Boeing told NASA that it is not looking for a quick return on its investment and does not anticipate a profit on the Jarvis program for at least 15 years. The company said it recognizes that "front-end funding will be very, very expensive." Boeing plans to offset this somewhat by procedures such as exchanging flight hardware. Boeing intends to procure the solid rocket boosters, external tanks and space shuttle main engines through NASA.

Initial flights will require thrust levels of 90-95% of engine capacity, which offers the potential of flying with used main engines. This will be done if Boeing can assure itself that the engines are totally reliable, Boeing said.

Jarvis is designed to put 31,000 lb. into polar orbit from Kennedy, 58,000 lb. into polar orbit from Vandenberg AFB, 79,800 lb. into a 150-naut.-mi. circular orbit and 76,500 lb. into a 220-naut.-mi. space station orbit from Kennedy. With a Centaur G Prime upper stage, Boeing said it can put 17,000 lb. in geosynchronous orbit from Kennedy.

Jarvis would have a payload fairing 27.5 ft. in diameter with a volume of 50,000 cu. ft. This is four times the volume of the shuttle orbiter, which has a 15-ft. payload diameter. Boeing said there will be significant cost saving through multiple manifesting possible with the large diameter and volume. Assessments were made on side mount and in-line payload accommodations. The in-line method has been selected because it scored better in performance, cost-to-orbit, payload accommodation and growth potential.

In the heavy-lift category, Boeing has projected there will be six Titan 4 missions and 9-12 shuttle missions annually and that Jarvis must have at least a mission cost equivalent to these vehicles to be acceptable. The most optimistic Jarvis market would total 10 per year, Boeing said. These would be two SDIO, three military, three NASA and two commercial launches. The company is using as its baseline two each for SDI, military and NASA, and one commercial, saying that "once Jarvis is implemented, the payload community will design to its throw weight, diameter and volumetric capability."

With a new cryogenic upper stage, Boeing said, Jarvis could conduct all planetary missions identified through the early 21st century. With its large fairings, including a hammerhead configuration 35 ft. in diameter by 70 ft. long, Jarvis can support SDIO work, including neutral particle beam experiments, target vehicle deployment experiments and test of space-based laser elements.

Growth versions of Jarvis could support initial deployment of an operational SDIO system. Versions using as many as three space shuttle main engines would have a low orbit capability of as much as 185,000 lb., Boeing said. ☐

Three Satellite Owners Reserve Space on Delta

Washington—McDonnell Douglas has signed four reservation agreements with commercial satellite owners to use Delta launch vehicles to orbit spacecraft that were canceled from the space shuttle manifest or that face delays because of the shuttle standdown, industry officials said last week.

American Satellite Co. and the International Maritime Satellite Organization (Inmarsat) signed reservations for one satellite each, while Comsat Corp. signed for two. McDonnell Douglas increased sales efforts for the Delta several weeks ago after NASA terminated discussions with Transpace Carriers on marketing rights to the vehicle (AW&ST Nov. 17, p. 28).

All of the reservations are contingent on the award of the Air Force medium launch vehicle (MLV) contract, for which McDonnell Douglas, General Dynamics and Martin Marietta are competing. An American Satellite official said his company hopes that McDonnell Douglas can provide launch service by 1990, but the manufacturer will not make available prices or schedules until early 1987, when the outcome of the MLV competition is known. McDonnell Douglas was soliciting reservations from satellite owners and asking for a $50,000 deposit.

McDonnell Douglas is the second U. S. expendable booster manufacturer to sign commercial launch reservations, and the first to sign customers with existing satellites. Martin Marietta signed a reservation to launch a Federal Express satellite, which has not yet been built, on a Titan 3.

Transportation Dept. Secretary Elizabeth H. Dole is expected this week to name Courtney Stadd, a Commerce Dept. official and former official in the expendable booster industry, as the new director of Transportation Dept.'s Commercial Space Transportation Office. Air Force, Transportation Dept. and NASA officials will brief senior managers from commercial expendable launch vehicle firms at Patrick AFB, Fla., this week on new government policies regarding their industry.

MX Missile Launched In Test Flight

Los Angeles—MX intercontinental ballistic missile was launched from Vandenberg AFB, Calif., Dec. 5, but two of the missile's 10 reentry vehicles did not deploy, according to telemetry data.

The missile, the 15th flight test missile in a series of 20 test flights, was launched at 8 a. m. PST from a modified Minuteman silo.

Air Force officials said all of the unarmed Mk. 21 reentry vehicles that separated from the missile and the two that remained attached to the missile's fourth stage and payload platform impacted within the Kwajelein Missile Test Range. Basic mission objectives for the flight were achieved, officials said.

The missile is in final verification of the operational missile system, with initial operational capability date for 10 missiles on alert at F. E. Warren AFB, Wyo., scheduled for the end of this month. Final test in the series is expected to be conducted during late summer of next year.

Military Communications Satellite Launched on Atlas Centaur

Cape Canaveral—The sixth Fleet Satellite Communications spacecraft was launched at 9:30 p.m. EST Dec. 4 by an Atlas Centaur in a nighttime liftoff.

Launch came 26 min. into the 3-hr. window, following a delay to recycle the count after redline values were exceeded in spacecraft telemetry readings. They quickly stabilized and the count resumed without incident. The FltSatCom spacecraft was injected into an approximately 100 × 22,234-mi. elliptical geosynchronous transfer orbit 28 min. after launch.

The spacecraft late last week was being positioned in a circular geosynchronous orbit that will enable it to drift to 105 W. Long. over the equator in geosynchronous orbit, where it will arrive in late January or early February. Control of the spacecraft will be turned over to the Navy at that time.

The TRW spacecraft is similar to earlier FltSatComs but includes an extremely high frequency (EHF) communications package, which will be used to test ground stations for the Milstar advanced military communications satellite system.

Liftoff of FltSatCom was delayed eight times from the original launch date of May 22 to reflect a new conservatism in launch operations following the failure of a Delta vehicle in May (AW&ST May 12, p. 20), which followed the shuttle Mission 51-L/Challenger accident Jan. 28.

The EHF package, built by the MIT Lincoln Laboratories, operates on 20 w. of power, transmitting on 20 GHz. and receiving on 40 GHz. These numbers are approximates because low and high rate frequency hopping is used.

FltSatComs are used by the military services worldwide on shipboard, in aircraft and on land bases.

The FltSatCom structure, which weighs 4,977 lb. at liftoff, has a span of 43.4 ft. between the tips of its solar panels. The main body is 7.5 ft. wide and 22.8 ft. high.

The main body consists of three hexagonal modules, the payload, spacecraft and EHF package. The solar arrays extend from the spacecraft module, which contains the hydrazine reaction control system thruster and propellant tanks, Sun and Earth sensors and reaction wheel.

Module Characteristics

The payload module contains the three antenna systems, transponders for 23 channels and communications electronics. The offset mast is the UHF transmitting antenna. A separate conical helix antenna on the central mast is the S-band tracking, telemetry and control antenna. The super-high-frequency antenna horn protrudes through a hole in the UHF antenna mesh. The EHF antenna consists of a 5-deg. steerable spot beam and an Earth coverage aperture, look-through cutouts in the center portion of the UHF transmitting antenna.

The solar arrays produce about 2,200 w. Three 24-cell nickel-cadmium batteries power the spacecraft when it is in the Earth's shadow. The battery is charged by 2,150 of the 23,000 available solar cells.

The FltSatCom launched last week with the EHF package is designated F7. It replaced F6 when the launch was postponed to check vehicle components and to rework suspect parts. Decision to launch the more advanced spacecraft was made by the Navy. F6 and the final FltSatCom, F8, are scheduled to be launched next February and May by the last two Atlas Centaurs with manifested payloads.

FltSatComs F7, F6 and F8 are all scheduled to be inserted into parking orbits to replace spacecraft as required. The satellites have five-year design lifetimes. All four now in orbit have exceeded this design. The forecast is that F7 will last 10 years. The EHF test capability will last an estimated two years.

Four FltSatComs are required for worldwide coverage 70 deg. above and below the equator. ☐

Claus Cleared

Transportation Dept. has awarded Kris Kringle d/b/a Santa Claus authorization to engage in air travel to various points throughout the U. S. on the night of Dec. 24-25. In granting the authorization, the department agreed that the applicant performs a vital and specialized transportation service. His equipment (including one reindeer with a special air navigation warning light) has not been officially certified by the Federal Aviation Administration, but has been determined to be airworthy since it has operated for centuries without incident. No allocation for fuel is necessary, but the applicant plans to carry coal for those who deserve it.

WASHINGTON STAFF

GAO Study Supports Need for SLC-6 Facility

Washington—Space Launch Complex 6 at Vandenberg AFB, Calif., will be needed to launch nine government payloads in 1992-94 and should be used in combination with expendable vehicles to provide assured access to polar orbit, according to a Dec. 5 General Accounting Office report to Congress.

The report said it will cost $200 million in Fiscal 1989 to keep the launch site in operational caretaker status, as the Air Force plans to do. Under operational caretaker status, a critical core of personnel would be retained, the pad would be kept compatible with the Kennedy Space Center facility and the launch pad would be capable of full reactivation within 18 months. Mothballing the facility would cost only $25.9 million in Fiscal 1989, but reactivation to full readiness then would require four years, Defense officials told the GAO.

The report was requested by Sen. James Sasser (D.-Tenn.), who has been critical of construction problems at Vandenberg and suggested that the facility be shut down, calling it "redundant and unnecessary" (AW&ST June 23, p. 17). Other members of Congress said the GAO report supports the Air Force plan to keep the launch site ready for use in 1992.

The GAO said $3.2 billion had been spent through Fiscal 1986 on the Vandenberg shuttle launch site. The Air Force is scheduled this month to choose a design change to alleviate a hydrogen entrapment problem in the pad's exhaust duct for the orbiter's main engines. Two alternatives under consideration are installation of a deflector to vent gas away from the duct and "steam inerting," which involves injecting steam into the duct to make the gas nonexplosive.

The nine payloads that require launch from Vandenberg in 1992-94 include classified military payloads and Space Test Program missions, the report said. Some of the military test experiments will be mounted on a reusable cargo bay carrier that occupies a quarter of the shuttle payload bay. One of the experiments will gather data on adverse effects polar orbit conditions can have on materials, equipment and technologies.

NASA needs Vandenberg for two launches to orbit space station polar platforms provided by NASA and the European Space Agency. The platforms will require periodic crew visits for servicing. Other NASA missions requiring Vandenberg are the Shuttle Radar Laboratory, which will gather data on polar ice caps, oceans and land, and the International Solar Terrestrial Physics program, which includes the launch of a NASA satellite to study the aurora borealis.

National Oceanic and Atmospheric Administration requires shuttle launches from Vandenberg for a weather satellite and remote sensing spacecraft in 1993. NOAA also will use the station free flyers for weather instruments.

Most of the missions were designed for shuttle launch because of the previous national policy requiring all government payloads to transition to the shuttle as quickly as possible.

Air Force and NASA officials said some of the payloads could be launched on expendable boosters, but Defense Dept. officials said a mixed-fleet capability from Vandenberg is preferred to provide assured access to polar orbit, according to the report. ☐

Full stack of lightweight space shuttle solid rocket motors was assembled at Vandenberg AFB, Calif., for a series of tests at the shuttle launch complex. The filament-wound motors, developed for shuttle launches from Vandenberg, are shown during joint freeplay tests inside the combined shuttle assembly building and mobile service tower. Hydraulic load train between the boosters is used to pull the motors toward each other.

NASA Halts Design of Shielding For Satellite Nuclear Power Sources

By Theresa M. Foley

Washington—The National Aeronautics and Space Administration has halted design of additional shielding for nuclear power sources on two planetary satellites after reaching a preliminary conclusion that the shields would help only during the first 2 min. of a space shuttle launch.

The work also was dropped because of findings that shields could increase the risk of accidental release of nuclear debris during phases of the flight other than solid rocket booster firing, according to a recently completed NASA analysis. "We see no benefit to continue the design work," a NASA official said.

Launch Approval

The Interagency Nuclear Safety Review Panel will not give launch approval until 1989 for the two space missions with radioisotope thermoelectric generator (RTG) power sources.

NASA officials said the prognosis is good for launch approval for the unshielded RTGs on the shuttle with Inertial Upper Stage (IUS) boosters. However, extensive additional RTG safety analysis must be done before approval by the panel. The RTGs have built-in protection that should prevent release of nuclear debris under most accident scenarios, NASA officials said.

The cancellation in June of the shuttle/Centaur upper stage because of safety concerns unrelated to the RTGs prompted NASA to reassess the risk of flying nuclear generators with other boosters. The solid-fuel IUS presents much lower health and environmental risks than the cryogenic Centaur booster, Galileo project manager John Casani wrote to NASA headquarters officials. The IUS has been selected to replace the Centaur for the Galileo mission to Jupiter and the Ulysses solar polar mission. "We are infinitely better off today than we were with Centaur," a headquarters official said.

The Challenger accident has increased attention to all aspects of shuttle safety. Congressional hearings were held in March to review risks associated with launching the RTGs on the shuttle with Centaur (AW&ST Mar. 10, p. 288).

The preliminary risk assessment, completed in October, concluded that shields would only help protect RTGs from flying solid rocket booster fragments, which would be present only during the first 2 min. of a mission. If the boosters exploded or were destroyed by range safety, steel case fragments could collide with the RTG at high velocity, causing release of nuclear debris. The shielding would offer protection in this situation, Casani said.

During other mission phases, however, shielding could increase the risk of radiation release, the assessment found. Galileo's flight path to Jupiter using an IUS requires the spacecraft to swing by Earth after shuttle deployment. If Galileo accidentally reentered the Earth's atmosphere during the flyby, and the shielding could not be ejected, it would prevent the RTG's nuclear pellets from dispersing as they are designed to do.

Instead, the nuclear pellets would reenter the atmosphere trapped inside the coffin-like shielding, NASA officials said. They would be unable to "float" independently to Earth for a soft landing and intact recovery later. The pellets and shield would instead crash land, followed by probable release of radioactive material. While NASA officials believe the probability of this type of accident is extremely low, they said the added shielding would have detracted from safety under this scenario.

Benefits Unclear

If the shuttle crash landed with the RTGs on board, the shielding might provide added protection but NASA officials said they could not quantify the extent of the protection or resulting benefits. "No one has figured out how to analyze a crash into the ground. It's not clear if a blast shield would add or detract from safety," a NASA official said.

The decision to halt shield design does not represent a final decision to abandon added shielding. However, NASA officials said that if the decision is reversed, it will be difficult or impossible to meet 1989-90 planetary launch windows. They also acknowledge the possibility that the interagency panel could refuse to approve the launches, which would result in a delay of several years or even cancellation.

The launch of the RTGs on shuttle/Centaur, which was scheduled for May, 1986, had not been approved by the interagency group at the time of the Challenger accident. NASA will continue to study accident scenarios and the associated risk of inadvertent release of radioactive material.

The latest cost estimate of the shields, which were being designed by General Electric Co., was $40-50 million each. The shields would have weighed 750 lb. each, exceeding shuttle/IUS margins for at least one of the missions. Although the weight increase could force NASA to use an expendable launch vehicle instead of the shuttle, planetary officials said the desire to keep the missions on the shuttle was not a factor in the decision to halt shield design. They also said cost and schedule implications associated with the shields played no role in the decision, which was based solely on the risk assessment. ☐

USAF Releases Draft Agreement For Commercial Launches

By Edward H. Kolcum

Patrick AFB, Fla.—A draft agreement covering launch of commercial spacecraft from Air Force facilities is being made available to potential users this week, Air Force Secretary Edward C. Aldridge, Jr., told a commercial launch vehicle symposium here last week.

Aldridge also said that the Air Force will accelerate its medium launch vehicle (MLV) procurement by selecting a contractor in mid-January rather than in February. Aldridge said that he has opted not to use the European Space Agency Ariane as a Navstar global positioning system (GPS) launcher. "We have studied this alternative in detail and have found it to be technically feasible. However, we determined that the domestically produced MLV, together with the shuttle, will meet capacity demands, do it cheaper than Ariane and attain the GPS operational requirements."

Capacity Consideration

He said Ariane came under Air Force consideration because of the lack of U. S. launch capacity, not because of cost, availability or reliability.

Descriptions of legalities, insurance, available and projected launch vehicles and facilities were outlined at last week's symposium to about 100 representatives of 75 potential user payload and launch vehicle companies. A second and more detailed meeting will be held here in late January after the MLV contract is awarded.

Aldridge said that, in the short term, the MLV competition is creating a dilemma for competitors who are reluctant to provide definitive cost quotes to other prospective customers. Competitors are the General Dynamics Atlas Centaur, Martin Marietta Titan 34D and McDonnell Douglas Delta.

For a brief period, USAF considered awarding contracts for two different MLVs, but that idea was discarded early this month. Aldridge said, however, that "Our decision on MLV will not foreclose other contractors from entering the commercial launch market. We will help them as we evaluate all commercial launch systems."

Aldridge stressed the need for a revitalization of the expendable launch vehicle inventory, which he called a national necessity following the shuttle Challenger accident. He said that if the Defense Dept. had not acted to procure 10 complementary expendable launch vehicles, it "would have been four years rather than two years away from being able to launch high-priority payloads."

He said the Air Force and NASA have a goal of reducing the cost of getting into space by a factor of 10 and then by a factor of 100. He said the Air Force will identify heavy lifter technologies able to put 100,000-200,000 lb. into near Earth orbit, with the Strategic Defense Initiative Organization an obvious user.

Dr. Charles W. Cook, deputy assistant secretary of the Air Force for space plans and policy, and other speakers at the symposium, said the objective of the government is to facilitate, not to subsidize. Robert H. Brumley, deputy general counsel of the Commerce Dept. and chairman of the Commercial Space Working Group of the Commerce Dept.'s Economic Policy Council, said one of the most significant aspects of the new commercial initiative will be insurance. "Insurance is an area where the government really wants to help you and at the same time not violate any principles," he said. "A case can be made that there needs to be government involvement in insurance" in such things as risk management and liability indemnification. "At the same time, it's very doubtful that the government will be the insurer of last resort. This is a potential drain on the Treasury, it violates what we're trying to do," he said.

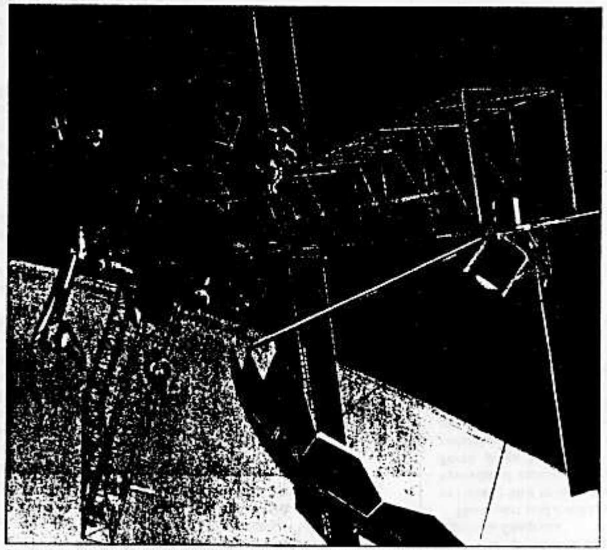
Barbara Stone of NASA's Office of Commercial Programs said her agency works with private companies by establishing umbrella agreements and subagreements. Umbrella agreements between headquarters and commercial companies cover launch vehicle operations and support. Subagreements, which are signed by NASA centers, are for use of specific facilities, equipment and services.

Stone said that Martin Marietta requested an agreement on Dec. 8 authorizing support of commercial Titan activities. NASA, she said, provided a draft agreement covering the Titan three days later. Status of the other launch vehicle agreements follows:

- Atlas Centaur agreement has been negotiated and signed by NASA and General Dynamics and is awaiting congressional approval. Purpose is to transfer to General Dynamics the authorization to operate the Atlas Centaur commercially.
- Atlas Centaur subagreement is under review. Purpose is to cover launch vehicle support including Kennedy Space Center services and use of NASA property.
- Delta negotiations began Oct. 23. Purpose is to transfer the authorization to operate the Delta on a commercial basis to McDonnell Douglas Astronautics Co.
- Conestoga memorandum of understanding was signed in September. Purpose is to authorize Goddard Space Flight Center and Space Services, Inc., to negotiate subagreements for launcher support.

Brig. Gen. Robert R. Rankine, director for space systems and command, control and communications at Air Force headquarters, said that under USAF's direct cost pricing policy, commercial users save substantially since recoupment of R&D money for facilities, depreciation and overhead are not charged for a launch. Direct costs can be clearly identified with a launch effort. Such costs as military labor, military leave and retirement, military operations and maintenance and contractor overhead are not charged to a launch.

Rankine said the Air Force will use three levels of management for commercial space programs. They are Air Force headquarters, where policy questions are resolved, Air Force Systems Command, the site for systems management, and Space Div., the initial contact point for the user. The Space Div. is the location for technical questions and for development and procurement, he said. ☐



Space station solar dynamic power system using a reflective dish to capture the sun's rays is in the foreground of this Rockwell International station concept. A new U. S. Defense Dept. position calling for Defense use of the space station will put international negotiations on hold.

Europeans Concerned by Delay In Planned Space Station Talks

Paris—A delay in the planned January, 1987, U. S.-European international space station negotiations is viewed by Europe as a potential setback in the efforts to complete terms of its participation in the multibillion-dollar program.

The European Space Agency had not been notified officially late last week of a delay in the next round of meetings—scheduled in Paris for the week of Jan. 19—but the prospect of such a postponement was causing concern among leading European space program officials.

"If U. S. problems force NASA to delay the January sessions, then we have to view this as a serious development," one high-level French CNES space agency manager told Aviation Week & Space Technology. "This could be an important setback, especially after all of the progress that had been made during our latest meetings in the U. S. last November."

The January sessions in France were to include negotiations on the ESA-NASA space station memorandum of understanding, as well as on the intergovernmental agreement between the U. S. and ESA's member states.

One ESA member country representative said Europe would be very worried about U. S. Defense Dept. attempts to influence management of the space station. "How many times have we been told by NASA that the Defense Dept. had no requirements for the station, and there wouldn't be defense-related problems that could cripple international participation?" he said. "Is this just one more turnaround in U. S. space policy that could impact America's relationship with its allies?"

ESA member nations had been briefed on the status of U. S.-European negotiations at the agency's final 1986 management council meeting, held Dec. 15 in Paris.

At the Dec. 15 meeting, ESA's management was optimistic about the program based on the progress made during the November meetings in Washington. The concern within ESA began to grow late last week, however, as it became evident that U. S. policies on use of the station were coming under review.

At the same meeting, ESA members approved a 1987 budget of $1.5 billion. This is an increase over the previous funding levels, which were $1.2 billion in 1986, and $1 billion in 1985.

Of this budget, $195 million will be spent on the development of space station and space platforms. The largest segment of the budget is the $362 million that will be spent on ESA's space transportation activities—mainly the Hermes manned spaceplane and Ariane launcher family.

The council also approved implementation of rules for management of the Hermes program. Hermes was proposed as a multinational project by the French CNES space agency, and was accepted earlier this year as an ESA program for the preparatory development phase.

Under the rules approved last week, ESA will have overall management responsibility for Hermes, although certain tasks will be delegated to CNES. This will be in contrast to the Ariane launcher program, which also is an ESA program, but for which the lead management role was taken by CNES.

ESA members authorized a continuation in the growth of the agency's permanent staff, which will increase from 1,628 to 1,850 by the end of 1987.

NASA Task Force Urges Fletcher To Buy ELVs for Civilian Use

Washington—NASA's mixed launch vehicle fleet assessment, completed last week, urged the agency to reintroduce expendable launchers for civilian missions, and offered policy options that could result in a $3-billion initiative beginning in 1987 to buy unmanned boosters.

Under the plan, about 35 expendable rockets would supplement the space shuttle, launching the equivalent of more than 30 orbiter cargo bays of payloads in 1988-95 that the shuttle will not be able to accommodate. NASA would need a supplemental appropriation to start an ELV program in 1987.

The recommendation to proceed with expendable launch vehicles (ELVs) resulted from a mixed-fleet study completed Dec. 15 by a NASA task force. The study found that Defense Dept. requirements of five missions per year, combined with space station requirements of eight annual flights, left inadequate launch capacity to carry out other government and civilian programs.

The assessment found that the shuttle would be able to fly 85-100 missions in 1988-95, but approved payloads require more than 135 missions. NASA officials believe the Defense Dept. will need five shuttle flights per year despite the large number of ELVs the military has purchased.

Payloads that would be transferred to ELVs, if NASA Administrator James C. Fletcher approves, include NASA science spacecraft, National Oceanic and Atmospheric Administration satellites, several commercial payloads and possibly some space station cargo. While immediate demand for expendable launchers is coming from the space science program, the space station office could make substantial use of the vehicles in the 1990s if Fletcher initiates an ELV program.

Strategy Briefing

Fletcher last week was briefed on NASA strategy and policy options for a mixed fleet by Darrell Branscome, special assistant to the associate administrator for space flight. Fletcher is expected to reach a decision in the next few weeks on a mixed-fleet plan that would provide direction on acquisition of expendable launchers, how to pay for them and how many to purchase.

The task force recommended six to nine options for a mixed fleet that covered various combinations of the shuttle and existing ELVs, including Delta, Atlas-Centaur and Titan 34D. The Titan 4 also was included because it is in advanced development, but other vehicle concepts, such as the Boeing/Hughes Jarvis, were not.

NASA program officials are not in complete agreement on how extensive the use of expendable vehicles should be. They also disagree on what numbers should be projected for future shuttle flight rates, with space shuttle officials continuing to endorse 16 missions per year. Other agency officials question the accuracy of that estimate, and believe that a National Research Council figure of about 12 shuttle missions per year at the most is more realistic (AWAST Oct. 20, p. 35).

Agency officials said that Fletcher's plan to acquire expendable vehicles will be shaped by many factors, including the varying estimates of achievable shuttle flight rates, estimated future Defense Dept. requirements and the availability and price of the medium launch vehicle.

An economic analysis conducted by space science officials found that transferring some satellites from the shuttle to ELVs could be justified on a cost basis. The analysis assumed a marginal cost of $40-80 million per shuttle flight, compared with an ELV cost of $60-70 million for Delta, $80 million for Atlas-Centaur, $100 million or more for Titan 34D and $250 million for Titan 4.

Space station and space science officials have completed internal program studies on use of ELVs. Station officials decided against changing the program to incorporate expendable launchers, but have left options open to allow the introduction of ELVs if Fletcher adopts an overall mixed-fleet plan.

Space station officials decided against including expendable launchers in the station design that will be the basis for the upcoming hardware contract competition. The benefit of accelerating station assembly by 6-9 months with ELVs was outweighed by the risks and costs associated with them, a station manager said. But NASA will retain an option in the contracts to use Titan 4s for the polar platforms to guarantee their launch from the West Coast, even if the Vandenberg AFB shuttle facility is not operating.

Station Resupply

Station managers are interested in using ELVs for resupply, but have not developed a firm plan to do so. Station planning calls for eight shuttle missions per year to exchange crews, and if the shuttle can meet that flight rate, additional ELVs for station logistics would not be required.

Several important factors have not been considered by station managers in concluding that the station does not require ELVs. The question of assured access must be addressed. Station managers must decide whether they can allow the station to depend on the space shuttle as the sole means of transportation.

Station officials also have accepted the projected flight rates of the shuttle program office without question. If the space shuttle is unable to provide 16 missions per year, then the space station is not likely to get the eight yearly flights it requires.

Space science managers have voiced the strongest demand for expendable vehicles and would like Fletcher to approve procurement of several additional ELVs in 1987 to supplement the Delta for the Cosmic Background Explorer that already has been approved. Space science officials hope to get approval to purchase an Atlas-Centaur for Rosat, the German/U. S. Roentgen Satellite that will conduct an all-sky survey of X-ray sources.

Science managers also believe that some of the smaller, secondary shuttle payloads could be launched on ELVs if they were grouped together on a free-flying platform. □

Atlas Centaur Lifts Payload to Orbit

FltSatCom spacecraft is carried into orbit by an Atlas Centaur from Cape Canaveral Dec. 4. This time exposure covers vehicle liftoff from Pad 36 to 40 sec. after ignition. Photo was taken by Malcolm Denemark/Florida Today with a Nikon FM using a 24-mm. lens from about 12 mi. from the launch pad.

Space Station Task Force To Analyze Operations

Kennedy Space Center—The NASA Space Station Operations Task Force will meet here during a three-week period in January to conduct functional analyses of station operations and prepare options for an actual operational concept.

The operations task force was formed in October and has been meeting at NASA headquarters since then (AWAST Sept. 15, p. 25).

The task force is made up of five panels, each with about eight members. The panels are:

- Space operations and support systems, headed by John T. Cox of Johnson Space Center.
- Ground operations and support systems, headed by Charles B. Mars of Kennedy.
- User development and integration, George Anikis, NASA headquarters.
- Management integration, Granville Paules, NASA headquarters.
- Zero panel, headed by Dr. Peter Lyman of the Jet Propulsion Laboratory and Carl Shelley of Johnson, who are cochairmen of the task force. Members are chairmen of the panels. □

NASA Reorganizes Kennedy Shuttle Management Team

Kennedy Space Center—The space shuttle management team here has been reorganized to align with the NASA headquarters shuttle organization and give added emphasis to safety and quality assurance.

Thomas E. Utsman has been named director of Space Transportation System Management and Operations, a new function and the focal point for coordinating shuttle activities at Kennedy with Washington headquarters. Utsman will retain his job as deputy Kennedy director.

Utsman's principal deputies are:

- Robert B. Sieck, launch director, previously director of launch operations.
- G. T. (Ted) Sasseen, engineering director, previously manager of advanced projects, technology and commercialization.

This structure puts operations and engineering into a single group and relieves Sieck and Sasseen of day-to-day administrative responsibilities. Other appointments:

- James A. (Gene) Thomas, director of safety, reliability and quality assurance.
- Charles D. Gay, shuttle operations.
- Jack H. Williams, logistics program management.
- Jackie E. Smith, vehicle engineering.
- Alan J. Parrish, ground engineering.
- Marvin L. Jones, protective services. □

Kennedy Photo Analysts Review Challenger Videos

Washington—Kennedy Space Center photo analysts last week were reviewing Challenger launch videotapes to search for any falling booster debris they could have missed earlier, following assertions by a private engineer that his analysis shows such debris in the launch photography.

The engineer, Ali F. AbuTaha, was to meet Dec. 19 with shuttle officials to review his analysis and a theory that loads on a strut between the external tank and Challenger's right solid booster could have been a factor in the Jan. 28 accident (AWAST Dec. 15, p. 16).

AbuTaha was to meet with a group headed by L. Michael Weeks, NASA deputy associate administrator for space flight-technical. Weeks initially was urged to hold the formal session by Burton I. Edelson, NASA associate administrator for space science and applications. Edelson is familiar with AbuTaha's work.

As of late last week, Kennedy photo analysts had not located the features described by AbuTaha, but were working without the engineer's guidance because they did not wish to contact him before he met with higher-level NASA managers. □

USAF to Push Asat Tests Despite Congressional Ban

Washington—The U. S. Air Force plans to keep its antisatellite weapons program alive and push for further space tests in Fiscal 1988 despite a congressional ban on Fiscal 1987 live-fire tests of the LTV Aerospace and Defense Co. miniature homing vehicle.

"The program will continue in one form or another," an Air Force official said. A reassessment of the $3.8-billion program has been under way since October after Congress renewed the ban it imposed in Fiscal 1986. The Air Force has rejected the more drastic options of canceling the program outright due to congressional opposition or declaring the system operational and beginning full-scale development without further testing. "I don't think we are close to either one," another official said.

Air Force officials are considering options to continue the program, and are working to fit the financial projections into next year's budget proposals.

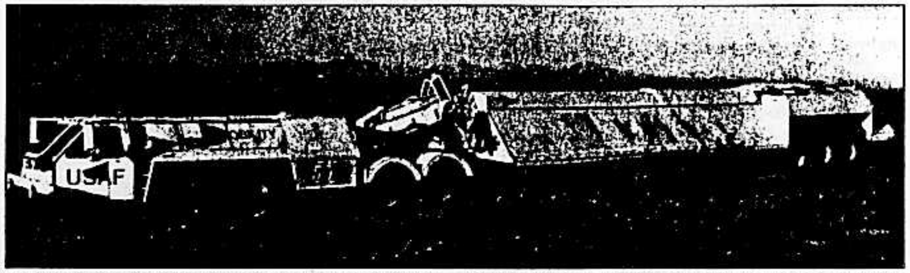
As a result of the congressional ban, the Air Force canceled three live-fire tests scheduled for Fiscal 1987 to further validate the ability of the system's miniature infrared homing warhead to intercept and destroy an orbiting satellite. Still in question is the fate of a satellite launched in December, 1985, carrying two instrumented test vehicles that were to act as targets. Procuring the two instrumented test vehicles and launching on a single booster cost the Air Force $20-22 million.

The satellite originally was expected to remain in orbit only until early 1987. Air Force officials said they have managed to extend its service life until next fall, beyond the end of Fiscal 1987 when the congressional ban expires, by decreasing communication contacts with the satellite to conserve its battery power. That keeps the option open for further tests if Congress does not continue the prohibition on tests on space objects in Fiscal 1988.

Stretching out the program will be difficult given the ban and the congressional decision not to authorize the $500 million requested by the Air Force to fund a production verification program, which was to have begun this year. The money would have funded design and test equipment improvements and increased testing.

The Air Force has conducted five live-fire tests of the Asat system launched from a McDonnell Douglas F-15, but only one, on Sept. 13, 1985, was against a target in space (AWAST Oct. 7, 1985, p. 18). Four other tests used predetermined points in space or infrared-emitting stars as targets.

Reagan Will Pursue Rail-Based MX, Full-Scale Midgetman Development



Air Force has selected Boeing Aerospace Co.'s Hard Mobile Launcher to carry the new single-warhead small ICBM. The 100-ft.-long, 200,000-lb. transporter/launcher, built by Boeing and main subcontractors Goodyear Aerospace Corp. and PACCAR Defense Systems Co., is equipped with two 750-hp. diesel engines and 14 all-terrain steel radial tires.

By John D. Morrocco

Washington—The Reagan Administration has decided to seek congressional approval to proceed with full-scale development of a 37,000-lb. small intercontinental ballistic missile with a single warhead, and to develop a rail garrison basing mode for the MX missile.

Under the rail garrison basing plan, MX missiles would be placed on railroad cars that would be housed at military installations around the country. In a national emergency, the cars would be dispersed at classified sites along the more than 200,000 mi. of track in the nation's rail system.

Gen. Charles M. May, Air Force special assistant for ICBM modernization, estimated it would cost $2.5 billion to develop the rail garrison basing system and another $4-5 billion to procure enough railroad cars and associated equipment to deploy 50 MXs.

Congress approved the deployment of the first 50 MXs in existing Minuteman silos, but has withheld funding for an additional 50 missiles the Air Force wants until a more survivable basing mode is adopted. The first 10 MX missiles deployed in refurbished Minuteman 3 silos at Warren AFB, Wyo., became operational on Dec. 22. The 50 MXs scheduled for deployment in existing Minuteman silos eventually could be deployed in the rail garrison mode, according to May.

The Air Force plans to ask Congress for "several hundred million dollars" in the Fiscal 1988 budget to begin developing the rail basing system, May said. The Air Force is seeking a December, 1991, initial operating capability date.

May estimated the total life-cycle cost to deploy 50 MX missiles in the rail garrison mode would be less than $15 billion. But the Air Force will not request any funds to procure additional MXs in the Fiscal 1988-1989 two-year budget request. May said the earliest the Administration would ask for additional MX missiles for the rail garrison system would be in Fiscal 1990, although long-lead funding may be included in the Fiscal 1989 request.

May said the Air Force is optimistic that the rail garrison MX system and single-warhead SICBM strategic modernization package will be endorsed by Congress.

USAF Conducts First Multiple AMRAAM Firing

Washington—The Air Force conducted the first multiple firing of a Hughes Aircraft Co. advanced medium-range air-to-air missile (AMRAAM) at the White Sands Missile Range, N. M., on Dec. 20 when a General Dynamics F-16C fired two of the missiles in a head-on attack against two QF-100 drones flying 2 mi. apart.

One of the missiles scored a direct hit, and the other came within lethal distance of the second target drone. The multiple launch capped a week of successful tests in the AMRAAM program. On Dec. 19, the USAF Armaments Div. conducted its first AMRAAM test at Eglin AFB, Fla. (AW&ST Dec. 2, 1985, p. 171).

On Dec. 18, an AMRAAM ejection-launched from a McDonnell Douglas/Northrop F/A-18 scored a direct hit on a low-flying QF-86 target drone over the Naval Weapons Center test range, China Lake, Calif. Two days before, the first AMRAAM separation test from a Grumman F-14 was conducted at the Pacific Missile Test Center, Calif.

While lawmakers have been critical of the Adminstration's MX proposals, there has been strong support in Congress for the SICBM, or Midgetman. The single-warhead missiles would be deployed on hardened mobile launchers in two modes—at existing Minuteman facilities and at random movement sites across the western United States.

The Air Force has selected Boeing Aerospace Co. over Martin Marietta Aerospace to develop the mobile launchers for the small ICBM. Boeing received a $283.7-million contract on Dec. 23 from the Air Force Ballistic Missile Office to develop its launcher, which is a wheeled vehicle that runs on specially designed Goodyear steel-belted radial tires. Martin Marietta proposed a tracked vehicle using rubber treads designed by Caterpillar Tractor Co.

The Air Force also awarded a $121.7-million contract to Morton Thiokol's Wasatch Div. to develop the SICBM's first-stage booster. Aerojet Strategic Propulsion Co. won a $179-million contract to begin development of the missile's second-stage booster, and Hercules Aerospace Products was awarded a $169.5-million contract for work on the third-stage booster.

Hercules also had bid to develop the second-stage booster. United Technologies Corp.'s Chemical Systems Div. bid to develop the first- and third-stage boosters but failed to win a contract.

The Air Force expects to make a final production decision on the SICBM in 1989 or 1990, allowing for an initial operational capability date of 1992. May estimated it would cost $40-50 billion to develop the SICBM and deploy a force of 500 of the single-warhead missiles.

The Air Force rejected recommendations to add additional warheads to the SICBM. An Air Force study begun last February found that a three-warhead version of the SICBM would not be sufficiently mobile.

A two-warhead version, which was considered nearly as mobile as a single-warhead missile, would have reduced the total life-cycle cost of the program by about 12% and saved an additional 25% in terms of manpower costs. But the option was rejected since it would have meant recompeting the propulsion contracts, which would have delayed the program for two years.

May said the single-warhead 37,000-lb. version will be capable of carrying penetration aids to help foil Soviet defenses.

The first SICBM is scheduled to be deployed at Minuteman facilities at Malstrom AFB, Mont. Succeeding missiles could be deployed at Warren AFB, Wyo., and Ellsworth AFB, S. D. Later SICBMs will be deployed on tracts of government land in the southwestern U. S. with Holloman AFB, N. M., and Yuma Proving Ground, Ariz., serving as the main operating bases.

Warren AFB also is set to be the main operating base for the MX rail garrison system. Additional garrisons will be located at defense installations across the continental U. S. Candidate locations include 10 Air Force bases, mainly Strategic Air Command bases, which could take advantage of existing nuclear weapons maintenance and security facilities.

Plans call for 25 trains carrying two MX missiles apiece, according to May, with as many as two to four trains stationed at each base. Each train will consist of six cars—a locomotive, two missile cars, two security cars and a launch command and control car. The missiles will be launched directly from the rail cars.

The Air Force intends to procure off-the-shelf railroad cars and equipment for the trains, since building special railroad cars hardened to protect against the effects of a nuclear blast would be extremely expensive and unnecessary, according to the Air Force.

The railroad cars will carry commercial markings to shield their identity. The Air Force also is considering building dummy garrison sites with decoy railroad sidings to further complicate the task of Soviet military planners. Other options include basing the missile trains on secret sidings instead of in the normal garrisons. □

Defense Dept. Seeks Launcher For SDI in Supplemental Budget

Washington—Secretary of Defense Caspar W. Weinberger has forwarded to Congress a $2.8-billion supplemental Defense Dept. budget request for Fiscal 1987 that includes $110 million for research and development of a new heavy-lift launch vehicle for the Strategic Defense Initiative.

"What we hope to do is get the technology that will enable us to lift heavy loads and the kind of platforms that would be required to implement the Strategic Defense Initiative," Weinberger said.

The supplemental request is aimed at restoring some of the funds eliminated by Congress when it passed a $289.2-billion defense spending bill for Fiscal 1987. If approved by Congress, the $2.8-billion request would raise the Pentagon's Fiscal 1987 budget to $292 billion, basically freezing defense spending at last year's level.

Weinberger is expected to ask for $312 billion in military spending when President Reagan submits the Fiscal 1988 budget request to Congress on Jan. 5.

Weinberger said the supplemental budget request involves some "extremely important programs," including military pay and benefits packages. It is highly unusual, however, to request funds to begin a major new program such as a heavy-lift launcher in a supplemental budget request, and with the current budgetary climate it is doubtful that Congress will approve the request.

Additional R&D Funds

The request includes $500 million in additional SDI research and development funding. Half of that amount is earmarked for space transportation technology research and development, including $110 million for a new heavy-lift launch vehicle. The remainder will go toward SDI research programs already under way, including:

- Space surveillance ($70 million).
- Directed energy activities ($70 million).
- Kinetic kill vehicle technology ($60 million).
- SDI systems architecture and engineering studies ($40 million).
- Survivability, lethality and key technologies ($10 million).

Weinberger said the additional funds were "vital" to maintain the pace of SDI research, noting that congressional funding cuts in the program in the Fiscal 1987 budget would mean that the Pentagon would have to stop some current research programs.

The additional SDI funding request does not reflect a move toward early deployment of the antimissile system, according to Weinberger, but rather "reflects advances in technology that allow us to move forward quicker than we had previously thought."

'Next Logical Step'

Weinberger said development of a new heavy launch vehicle (HLV) is the "next logical step" in the SDI research program. "It has become apparent to us that it is increasingly important to lift heavy loads into space," he said. The new rocket could be used to help boost components of the proposed space station into orbit, but Pentagon officials said that the SDI program was the "driving factor" behind the move for a heavy-lift launcher.

An SDI Organization official said the money would be used to explore "a broad range" of current and new technologies for a launcher with a 100,000-150,000-lb. lift capability, which would be double or triple the payload capability of the shuttle. The use of both expendable and reusable manned launch vehicles would be explored, according to Weinberger. The Pentagon wants to begin technology research studies this spring and have a heavy-lift vehicle ready by the mid-1990s.

Current candidates for the heavy-lift role include a United Technologies Corp. proposal for an unmanned payload carrier, which is basically a shuttle derivative, and Boeing Aerospace Co.'s Jarvis design (AW&ST Dec. 15, 1986, p. 22).

Other funding requests in the Fiscal 1987 supplemental request include $120 million for enhanced operational test and evaluation support. Of those funds, $10 million would be spent to acquire four additional deep, fast undersea targets; $34 million for helicopter targets, and $76 million for Navstar Global Positioning System instrumentation and threat simulators for test ranges.

Another $60 million has been requested to fund the North Atlantic Treaty Organization's cooperative armaments research and development program and $240 million for additional war reserve ammunition stocks.

The supplemental request also includes $330 million for additional Special Operations Forces aircraft and equipment. The funds would be used to modify H-53, C-130 and C-141 aircraft for low-level, night missions; procure three additional Lockheed MC-130H aircraft, and to add a refueling capability to eight more MC-130Es.

Sagan's Views of Space Program: Pros & Cons

Mr. Sagan's comments on the direction of our efforts in space are excellent (AWAST Dec. 8, p. 11). It's about time for our nation to realize our true potential in space again. Mr. Sagan was correct indeed when he stressed the importance of "providing a focus and sense of purpose to a dispirited NASA."

The catalyst could only be a mission having bold proportions similar to those that sent us to the Moon: the goal of manned exploration of the planet Mars within the next 10-15 years. When President Kennedy asked Congress to fund our lunar landing efforts in 1961, he declared, "No single space project in this period will be more impressive to mankind or more important for the long-range exploration of space." We are faced with an equally impressive opportunity today.

I believe we are up to the challenge.

John P. Schreitmueller
Plano, Tex.

Carl Sagan, whose stacked-deck nuclear winter theory thoroughly illuminates his political bias, is at it again.

His Mars exploration editorial is an exercise in sophistry against defense in general and SDI in particular.

He builds his case for this enterprise on his question, "What if sometime in the next few years a general strategic settlement with the Soviet Union is achieved—as is clearly longed for by people all over the world?" There might be some foundation to that premise if our chief adversary were England, France, Canada, Italy or some other representative government. The Soviets, however, are not impressed by what other people (or their own) "clearly long for." Anyone who hasn't recognized that difference is suffering from a retarded instinct for survival.

A mission to Mars should stand or fall on its own merits when weighed against other current real world needs as any other program in our budget must. Sagan's proposal is an end run around that principle, implicitly suggesting that a Mars mission be substituted for some "foolish" defense spending. It is an attempt to advance his own antidefense point of view.

Thomas Swift
Sun Valley, Calif.

Dr. Carl Sagan was right on target on the need for the U. S. to make a long-range commitment to explore the planet Mars. Our country's space program has been drifting aimlessly for far too long. Whether it be Mars, the Moon or Pluto, for that matter, the U. S. must immediately establish its long-range space goals and begin working toward them if we are to recapture the glory that was once our space program.

However, having agreed with the basic tenet of Dr. Sagan's editorial, I have problems with some of his statements.

Although it may go over well with the nightly news and the general public, a few paragraphs and the wave of a hand will dispose of neither SDI nor the problem of strategic nuclear arms. The AVIATION WEEK & SPACE TECHNOLOGY readership deserves better than simplistic arguments and premature conclusions.

Dr. Sagan insinuates that the U. S. could have a first-rate space science program or SDI, but not both. The U. S. could finance both, just as the U. S. financed the Apollo program and the Vietnam War simultaneously. It would not be easy, but it also would not be impossible.

If other free world countries wished to join us in either or both endeavors, so much the better. Furthermore, if it does come down to a choice between a Mars exploration program and a defense against a sworn enemy, I, for one, choose defense. Mars will always be there tomorrow; our country and our freedoms may not.

Dr. Sagan suggests that the U. S. work with the Soviet Union on a Mars program "on behalf of the human species." That would be difficult to do, seeing the atrocities that the Soviet Union has committed against the human species, such as capturing Afghan villagers, who are members of said human species, binding them hand and foot, stacking them, alive, like firewood, dousing them with gasoline and setting them afire. Perhaps Dr. Sagan's conscience will allow him to work with such people. Mine won't.

Pepper P. Powers
Cocoa, Fla.

On to Mars! What an intriguing idea. All the reasons outlined by Carl Sagan for this mission are excellent, but I see a problem.

It isn't the lack of money (billions and billions?), presidential and congressional support, a coherent goal for NASA or the loss of many of their first-rate people. Rather, it is all of these things, it is one of management.

NASA doesn't have the top management expertise on board at this time to handle a venture of this magnitude. The shuffle brought about by the Challenger accident simply moved the bureaucrats around.

It is time for NASA to find a leader who can get the presidential and congressional support and who can get the money and all the rest.

It is time to get someone in there who knows how to run a business.

This man doesn't have to be an engineer and in fact probably shouldn't be. On the whole, NASA's engineering seems to be competent (although I worry a little about any engineer who can defend SDI with a straight face).

It is time for the President and the Congress to locate a man who can take charge. We'll send the professional bureaucrats (since we can't fire them, more's the pity) to some agency where performance and results are not as important as inertia.

(As of this writing, Ross Perot is out of a job.)

William B. Dick
Colleyville, Tex.

I agree completely with Dr. Sagan's call for a program of human exploration of the planet Mars. I would add only this: We must recreate a civilian space program dedicated to the goals of scientific and commercial exploration and exploitation of space. The space program is and must be more than simply a means to greater scientific knowledge. It is a means to ensure the survival of the human race.

I only hope that we can bring this fact to the attention of our political leaders before that means is lost to us forever.

James C. Douglass
Boulder City, Nev.

I am amazed and distressed that AVIATION WEEK & SPACE TECHNOLOGY would feature Carl Sagan's antidefense, "peace-movement" polemic thinly disguised as a plea for manned flight to Mars. One would expect to find it in "Parade" or "National Enquirer." Please be more discriminating in the future.

Francis C. Bolton
Sunnyvale, Calif.

Carl Sagan is right. Let's go.

Pat Stakem
Laurel, Md.

It is a disservice to the publication and its readers to print articles by intellectual lightweights like Carl Sagan.

His view that SDI cannot be made to work is the same sort of hogwash we heard from "competent observers" about putting men on the Moon. Why is it that the Russians have been spending billions over the last 10-15 years developing a technology that won't work?

I hope this is the first and last case of having such mediocrity in the magazine.

G. M. Wilson
Ft. Lauderdale, Fla.

AVIATION WEEK & SPACE TECHNOLOGY welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, AVIATION WEEK & SPACE TECHNOLOGY, 1221 Avenue of the Americas, New York, N.Y. 10020. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names will be withheld. We reserve the right to edit letters.

Salute to Voyager

For years it has been the tradition at AVIATION WEEK & SPACE TECHNOLOGY to devote this page in the first issue of the New Year to a listing of those individuals who made outstanding contributions in the field of aerospace during the preceding 12 months. At the risk of breaking a time-honored tradition, Aviation Week will postpone its annual Laurels editorial until the second issue of 1987 and devote this column to a single extraordinary event that occurred in the closing days of 1986. That event, of course, was Voyager's spectacular nonstop, unrefueled flight around the world.

The nine-day, 25,000-mi. odyssey Dick Rutan and Jeana Yeager completed in the unique Voyager aircraft, designed and built by Burt Rutan and his talented team at Mojave Airport, Calif., captured the attention of citizens around the world. If one had to cite the single most important accomplishment of this fantastic flight, tops on the list would be the respite it gave a world jaded by a daily diet of turgid reports on the political scandal in the U. S., terrorist attacks and riots in Europe, human rights outrages in the Soviet Union and South Africa, and the interminable fighting in the war-ravaged Middle East and Afghanistan.

News agencies around the world broadcast daily—sometimes hourly—reports of the Voyager crew's progress starting with their harrowing takeoff from Edwards AFB, Calif., Dec. 14; through their nine-day battle against the weather, mind-numbing fatigue and a sometimes cantankerous flying machine, and finally to their triumphant return to California Dec. 23. After several graceful flybys over the large welcoming crowd at Edwards, during which he seemed reluctant to end the flight, Dick Rutan brought Voyager in for a whisper-soft landing on the Edwards dry lakebed.

A Triumph of Spirit

Many questions have been raised about the technological or operational significance of the Voyager flight, as if the undertaking needs to be justified on the basis of the spinoff it will provide to military and civil aviation endeavors. There will be more than a little of both, but why not for the moment just accept the Voyager flight for what it was—a triumph of the human spirit?

The flight culminated a six-year quest by the Brothers Rutan, Jeana Yeager and a team of another 40 persons, many of whom donated their time. Where else but in the U. S. could a project of this magnitude take form during a discussion between two brothers over lunch in a small desert town coffee shop? Once Burt sketched the design he thought would meet the challenge of carrying two pilots more than 25,000 mi. without enroute stops or aerial refueling, the dream came alive and there was no looking back.

The Rutan brothers are unique individuals with many different personality characteristics. But they share an ability to doggedly pursue their dreams and are complementary in many other ways that ideally suited them for achieving this historical feat. Burt brought his design genius to bear on the project, while Dick applied his piloting skills and extensive operational experience. Jeana Yeager, who also has a solid aviation background, added an entirely different element to the formula and proved to be a steadying influence both during the development of Voyager and throughout the globe circling flight.

It is difficult to estimate the total cost of the Voyager project because so many members of the team volunteered their time and several corporate sponsors donated goods, services and equipment. An estimated price tag of $2 million has been put on Voyager, but the actual figure could well be less than that. Even if it were double the estimate, it still would be a bargain as well as a tribute to the low-key, cost-effective way things are done around the Rutan Aircraft Factory at Mojave Airport.

Technology Breakthrough

The aircraft was handbuilt over a period of 18 months by Voyager Aircraft, Inc., a company Dick Rutan and Jeana Yeager formed specifically to develop a machine that could complete the record breaking flight. The final product is an unusual twin-engine design—ungainly and yet sleek, streamlined and beautiful in its own way. Its primary breakthrough is the way in which it combines a variety of advanced, and yet state-of-the-art technologies, ranging from its graphite composite and honeycomb structure to its slim 110.8-ft. high-aspect-ratio wing.

In fact, Burt Rutan said early in the Voyager design process that the basic rule was to keep the aircraft simple and avoid using any experimental or otherwise unproven systems or technology. Other than the use of graphite composite for all elements including basic structure, this policy generally was followed. The one exception—an initial attempt to use advanced propellers—almost brought the project to grief when a modified blade broke loose during a test flight and the resultant vibration of the unbalanced propeller tore the forward motor off its mount before Dick Rutan could shut it down.

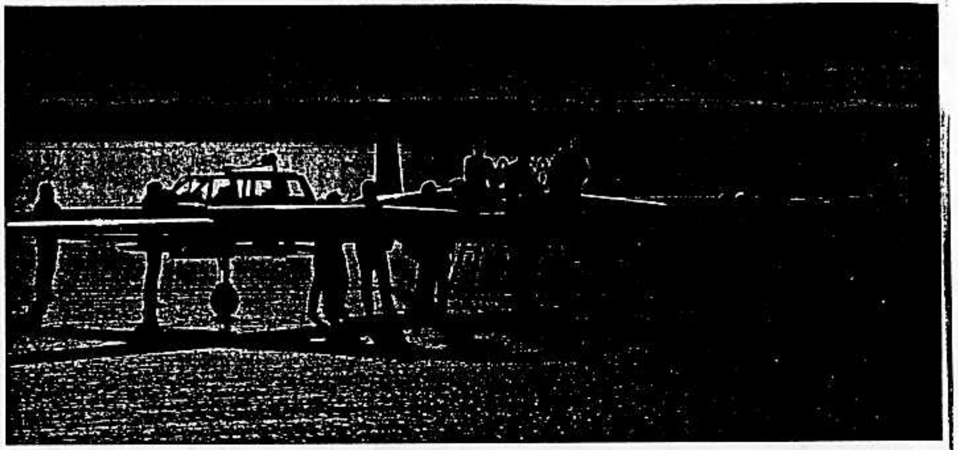
With the successful globe girdling flight completed, engineers from NASA, the Defense Dept. and various aerospace companies will want to inspect the Voyager airframe and add their assessments to the growing database on composite structural materials. Proponents of high-altitude, long-endurance (HALE) aircraft for various manned and unmanned reconnaissance and surveillance missions will take heart in Voyager's endurance. And, aerodynamicists and structural engineers will draw insights from Voyager's performance, which enabled it to lift a whopping ten times its basic structural weight.

In the final analysis, however, the Rutan brothers, Jeana Yeager and the Voyager team are to be saluted for an even greater achievement—the excitement they generated as their ungainly craft chugged around the world at an average speed of 115.8 mph. It is heartening that the spirit of the early age of aviation could be felt again in a world grown accustomed to the fire, smoke and sonic booms of the supersonic jet and space age.

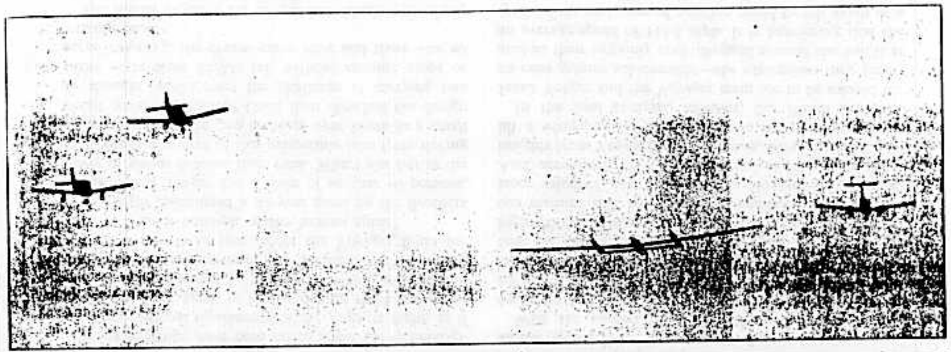
Another famous aviation brother team—the Wrights of Dayton, Ohio—would have loved it.

—Donald E. Fink/New York

Voyager Flight Demonstrates Value Of All-Composite Aircraft Design



Richard G. Rutan and Jeana Yeager sit on Voyager fuselage following their nine-day flight in Voyager's cramped 7.5-ft.-long, 3.3-ft.-wide and under 3-ft.-tall cockpit (above). Yeager is at left, Rutan in cowboy hat is at right. The crew sat a few minutes on the aircraft before trying to walk. Voyager arrived over Edwards AFB with an escort of chase and photo aircraft. Three are shown opposite page, top, with Voyager. Rutan and Yeager made several low passes before landing Voyager on the Edwards AFB dry lakebed (photo at right) at 8:06 a.m. PST Dec. 23. Voyager officials estimate the aircraft landed with approximately 15-20 gal. of fuel remaining. About 7,000 lb. of fuel was carried for the flight. Photo at bottom right shows Burt Rutan, left, Yeager and Dick Rutan after receiving Presidential Citizens Medals from President Reagan at a ceremony on Dec. 29.



Wide World

Edwards AFB, Calif.—Voyager pilots Richard G. Rutan and Jeana Yeager earned a place in aviation's record book with the completion of their nine-day, nonstop, unrefueled flight around the world—a feat that demonstrated the viability of all-composite aircraft structures under extreme conditions ranging from a takeoff with wingtip-dragging fuel loads to severe turbulence en route.

The flight also demonstrated the endurance capabilities of the crew under these difficult circumstances, and heightened the possibilities that such an unconventional design—either manned or unmanned—could satisfy emerging requirements for long-duration airborne communications relay and aerial surveillance/reconnaissance applications.

Rutan and Yeager flew Voyager 25,012 stat. mi. at an average speed of 115.8 mph. They took off from Edwards AFB, Calif., Dec. 14 and returned for a landing on the Edwards dry lakebed Dec. 23, 9 days, 3 min. and 44 sec. later, nearly doubling the previous distance record of 12,532 stat. mi. set in 1962 by a USAF/Boeing B-52H.

The successful flight is the culmination of a nearly six-year effort by Dick Rutan and Yeager's Voyager Aircraft, Inc. The undertaking began with a handful of people and ended with a team of more than 40, mostly volunteers, and some corporate sponsors.

The graphite composite Voyager, built almost entirely of donated Hercules Magnamite fiber and Hexcel honeycomb, was built by hand during an 18-month period. The remaining time before the flight was spent in flight test, equipment validation and fund raising. The aircraft has now completed the only flight it was designed to make, Burt Rutan, Voyager's designer and president of Scaled Composites, Inc., said.

"I hope this will inspire others to use all composites in their designs," Burt Rutan said. "I think there can be some real benefits if manufacturers will stop mixing small amounts of composites with metals and begin taking full advantage of composite construction."

Instances of extreme turbulence over the Pacific, African continent and the Atlantic, equipment problems and nagging fatigue made it a difficult trip for the crew.

The flight was aided for most of the route by unseasonably favorable tailwinds that allowed the aircraft to arrive back at its starting point a day early.

"Increased drag from the wingtip damage, the course deviations due to weather, restarting the front engine several times to climb and running the front engine an extra day gave us many concerns about the fuel," Burt Rutan said. "The much better than expected tailwinds balanced these out."

Voyager cruised between 7,000 and 11,000 ft. for most of the flight, but reached altitudes over 20,000 ft. to avoid turbulence over Africa.

Voyager officials estimate that the aircraft landed with about 15-20 gal. of fuel remaining.

Burt Rutan and Mike Melvill, flying in a Beech Duchess chase aircraft, intercepted Voyager off the coast of California around sunrise Dec. 23, about 69 mi. south of Long Beach and escorted it to Edwards for landing. Voyager, the Duchess and other chase and photo aircraft arrived over Edwards at about 7:35 a.m. PST.

Dick Rutan circled Voyager above Edwards to lose altitude and made several low passes before Yeager lowered the hand-powered landing gear.

Rutan flew Voyager at a final approach speed of 54 kt. while Melvill called out the remaining altitude to touchdown at 8:06 a.m. PST.

Rutan used both of Voyager's engines for the approach and used only about

3,000 ft. of the lakebed for landing and rollout.

The crew took several minutes to exit Voyager and paused to sit on the edge of the cockpit before attempting to climb down and walk.

After a few tentative steps, both Rutan and Yeager were able to walk with little assistance. Both were taken by ambulance to the base hospital for examination.

Rutan and Yeager said they were "a little wobbly and fatigued," but looked fit considering their nine days in the cramped and noisy cockpit.

The crew said they drank plenty of fluids, but ate very little.

"We really had no time and no appetite," Rutan said. "We were busy monitoring the aircraft's performance, taking data, managing the fuel and maintaining Voyager's proper weight distribution. There was never any idle time."

Several weather and aircraft systems challenges during the flight also kept the crew occupied and allowed them little sleep.

Voyager's planned route changed daily to avoid severe weather and take advantage of unusually strong tailwinds. Thunderstorms caused the crew to retreat from their intended course and restart the front engine to gain altitude and climb above rough weather several times.

The crew and team of meteorologists working from Mojave kept Voyager away from typhoon Marge and most turbulent weather in the Pacific/Asia region early in the flight. But the weather forced Voyager's path to be altered across the midsection of Africa, and tailwinds placed the aircraft over the continent during some daylight hours.

Rough Ride Over Africa

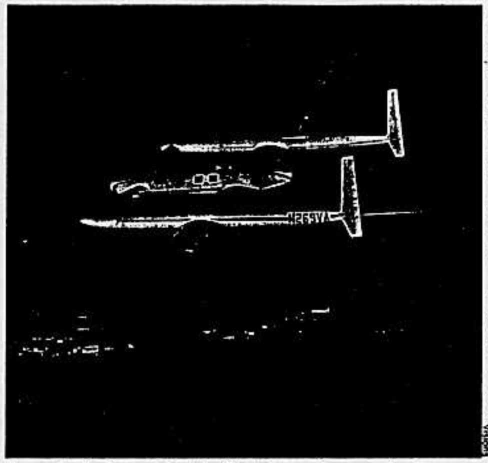
Thunderstorms generated during the day over Africa tossed Voyager repeatedly and forced the aircraft to fly as high as 20,000 ft. to avoid the weather. The ordeal left the crew shaken and bruised from the rough ride. Favorable winds raised Voyager's ground speed to over 165 mph.

A chase plane flew formation with Voyager over part of Africa and conducted several tests to help determine the aircraft's weight. The tests were needed to attempt to verify how much fuel remained.

"We conducted three tests: twin engine climb, one engine climb and cruise performance to estimate its weight," Burt Rutan said. "We did not do a stall test."

The tests gave Voyager officials an initial feeling that they had more than enough fuel to complete the flight, but erroneous fuel meter readings on the aircraft continued to make fuel estimates uncertain.

Having crossed Africa, the crew expected that the hardest part of the trip had been completed and they would have smooth weather the rest of the way.



Voyager's wingtips sustained significant damage from scraping the runway during the Dec. 14 takeoff roll. About 2.5 ft. of graphite fiber skin is missing from the top and bottom of the left wing's foam core.

Visions

Fatigue probably caused the crew to neglect checking the rear engine's oil supply as planned every six hours, and an oil warning light and rising engine temperatures startled Rutan and Yeager while over the Atlantic. Rutan quickly pumped additional oil to the Teledyne Continental IOL-200 liquid-cooled engine from a reserve tank while Yeager flew the aircraft and monitored the temperature. The engine's temperature returned to normal and the engine continued to run without any apparent damage.

Voyager Coverage

Coverage of the record-setting flight of the Voyager aircraft in this issue and in our Dec. 22, 1986, issue was provided by the Los Angeles bureau of Aviation Week & Space Technology: Bruce A. Smith, bureau chief, and Keith F. Mordoff and Michael A. Dornheim, engineering editors.

Voyager used synthetic oil provided by the Mobil Oil Corp.

Later, the crew received warning from their meteorologists at Mojave of an unexpected small storm in front of them off the coast of Brazil. Voyager was unable to avoid the storm and encountered the most severe turbulence of the flight.

"Dick lost it for a few seconds when Voyager was tipped way up into a 90-deg. bank," Burt Rutan said. "It took 4-5 sec. to right the aircraft. They had several of these; we were very concerned."

Dick Rutan said he never felt comfortable banking Voyager over 15 deg. Voyager's handling characteristics always have been described by Rutan as "mission adequate."

"The aircraft was built with several compromises and flying qualities is one that became obvious during the flight," Dick Rutan said.

The Voyager crew retreated from the storm and flew south to remain clear. Voyager proceeded up the eastern coast of South America and was directed to cross Central America and fly up the western coast of Mexico to avoid strong headwinds and poor weather on their intended route up the Gulf of Mexico to Texas and over the southwest.

Voyager's rear engine was throttled down to between 1,800-1,900 rpm. and was using a little over 3 gal./hr. to propel the aircraft at an indicated 76 mph. at that time in the flight, Burt Rutan said.

Voyager crossed Central America over Costa Rica and encountered headwinds for the remainder of the flight. The 12-15-kt. headwinds were much less, however, than winds forecast for Texas.

Rutan and Yeager's final challenges began when one of Voyager's two electric fuel pumps failed. Rutan then used the rear engine's mechanical fuel pump to draw fuel directly from the selected tank into the rear engine.

Off the coast of Baja on the last night of the flight, Rutan began a descent from about 8,500 ft. in an attempt to find an altitude that would offer less headwinds than the increasing 20-kt. winds they were facing. The engine pump was drawing fuel directly from a canard tank to the rear engine and bypassing the failed electric pump. The engine pump soon was unable to pump the fuel from the canard with Voyager in a nose down attitude, and the engine stopped from fuel starvation.

Voyager glided for several minutes before Rutan was able to determine the problem and start the front engine. He then raised the nose, which restored fuel to the rear engine so that Rutan could easily restart the rear engine. The aircraft lost over 2,500 ft. during the incident, according to Burt Rutan.

It was the second time the rear engine stopped during the flight. Dick Rutan starved the engine of fuel earlier when he ran a tank dry before switching to another. Voyager officials elected to have the crew keep both engines running for the remainder of the flight as a precaution after they were sure there was enough fuel to do so.

Rutan and Yeager decided to rerig the fuel line plumbing to use the remaining left side electric pump to draw fuel from the right side to balance the center of gravity. The change was easily done, but a small amount of fuel was spilled in the cabin. The crew vented the cabin and used oxygen until the fuel vapor cleared.

Other technical problems in the flight included intermittent communications and a component failure in the autopilot system that was quickly fixed.

"The engines and avionics worked about flawlessly," Dick Rutan said. "We had the autopilot on about 98% of the flight, and the engine's fuel burn numbers were better than expected."

Voyager's Teledyne Continental engines, TRW/Hartzell propellers and King Radio Corp. avionics were donated by the companies.

Rutan said the Bose noise cancellation system worked well, but other Voyager officials said the crew was unable to use the headsets while using the radios.

Close-up view of the wingtips after landing revealed that composite material had been torn away from the top of both wingtips as well as the bottom. Project officials were surprised that the exposed blue foam core material retained its airfoil shape and did not wear away.

The right tip was the more heavily damaged of the two, though more skin—about 2.5 ft.—was missing from the left wing. Electrical wires for the missing right wingtip navigation light had pulled through the top of the foam and trailed back a couple feet from the wing in flight. An approximately 15-in. piece of carbon fiber skin hung below the wing.

"That piece was there after we lost the winglet at the beginning of the flight," Burt Rutan said. "I never thought it would stay on very long."

Voyager was scheduled to be flown back to Mojave by Rutan and Yeager late last week. The aircraft will remain there for several months until a decision is made on its donation to the National Air and Space Museum in Washington D. C.

President Reagan awarded Dick Rutan, Yeager and Burt Rutan Presidential Citizens Medals in Los Angeles Dec. 29 in recognition of their achievement. □

Design, Structural Materials Key to Round-the-World Flight

Edwards AFB, Calif.—Innovative flight testing while over Africa to determine Voyager's gross weight was one of many aircraft performance tasks necessary to complete the record-setting flight.

Voyager was able to complete its 25,000-mi., nonstop, unrefueled flight around the world because its design and structural materials allowed it to carry an unprecedented fuel load in a sleek, low-drag shape.

Voyager's takeoff weight was more than 10 times the structural weight, but its drag was lower than almost any other powered aircraft. The takeoff weight was 9,760 lb., basic structural weight without engines or systems was 938 lb. and zero-fuel weight was 2,760 lb.

The lift-to-drag ratio is 30-33:1, although this may have been degraded by several percent due to the loss of the winglets, which were damaged during the takeoff roll and subsequently broken off inflight, according to John R. Norris, Voyager mission control technical director. This ratio is comparable to a moderately good glider, and twice that of an efficient light piston aircraft.

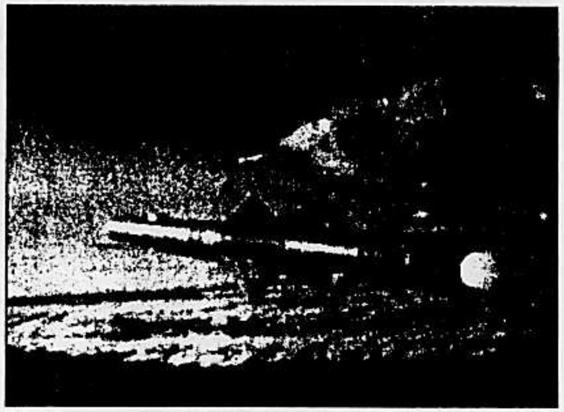
There was concern that numerous insect strikes on the wing leading edges could spoil the airfoil's laminar flow and increase drag, but almost no insect remains were found after landing.

"We were concerned that if we picked up many insects on the leading edges over Africa that our cruise performance would be significantly degraded. Fortunately, we flew over Africa at higher altitudes, most of the flight was over water and few bugs were picked up taking off and landing," Voyager designer Burt Rutan said.

The 110-hp. Teledyne Continental IOL-200 liquid-cooled engine in the rear of Voyager was operated generally at full throttle for best specific fuel consumption and propeller efficiency. Power was regulated by changing engine speed via the Hartzell constant-speed propeller. The engine was run as slow as 1,600 rpm. at the full manifold pressure available at altitude, but this speed was undesirable because the low power tended to foul the spark plugs and partial stalling of the propeller blades caused airframe buffet.

Properly adjusting the engine's fuel-air ratio was a key element in completing the trip, Norris said. The specific fuel consumption could degrade by 10% if the mixture was not fully leaned. Cruise specific fuel consumption of the IOL-200

Antiradar Missile Launched from Tornado



British Aerospace Alarm (Air-Launched Antiradar Missile) leaves the launch rail of a British Royal Air Force Panavia Tornado during test firings over the Aberporth range in Wales. Two unguided missiles were fired to test the launch sequence. A guided version of the missile then was launched. It homed on a simulated hostile radar transmitter. The missile is being developed for the RAF, which selected it over the U.S.-designed HARM missile.

typically is about 0.38 lb. of fuel per hour per horsepower, compared with about 0.42 for the air-cooled, carbureted, lower-compression O-200, according to David L. Mayrose, Continental Voyager project engineer. The IOL-200 runs rough when adjusted for best specific fuel consumption, at a mixture leaner than that for peak exhaust gas temperature.

Voyager's ultimate range is estimated to be 27,000-28,500 naut. mi. The official ground distance covered on the flight was 21,735 naut. mi., although the actual ground distance may have been greater due to circuitous routing flown to avoid weather. An estimated 15-20 gal. of fuel remained in Voyager's tanks on the landing back at Edwards.

At a 6,000 lb. mid-cruise weight, single-engine mileage would be 3.53-4.1 naut. mi. per lb. of fuel, depending on how well the engine fuel/air mixture is leaned. Two-engine mileage at the same weight ranges from 2.68 to 3.04 naut. mi. per lb. of fuel.

The aircraft usually was flown on an airspeed versus gross weight schedule to achieve desired lift coefficients. However, since early fuel flow readings were erroneously high, the aircraft was thought to be lighter than it actually was and target airspeeds were lower than optimum. Degraded handling resulted from flying at the higher lift coefficients. Actual gross weight was later estimated over Africa with the help of a chase aircraft by measuring the aircraft's climb and cruise performance at known power settings, and noting the pitch attitude at given airspeeds since an angle-of-attack meter failed when the indicator needle fell off. ☐

Defense Dept., NASA Aid Voyager Communications

Mojave, Calif.—Voyager was able to communicate with mission control around the world through the use of Defense Dept. and NASA systems, and flight officials said the trip would not have been possible without this help.

Two basic links were used to connect Voyager pilots Richard G. Rutan and Jeana Yeager to mission control center here:

- Direct ultrahigh frequency (UHF) satellite link to the aircraft, using a hand-held antenna in the cabin pointed at the nearest satellite.
- High frequency (HF) communications with local ground stations, with a variety of routings to mission control.

Government Cooperation

Government cooperation with the Voyager project was found to be in the national interest by the State Dept., which recommended to Donald C. Latham, assistant secretary of Defense for command, control, communications and intelligence, that the Defense Dept. lend communications assistance. Latham sent a letter endorsing this position to the Joint Chiefs of Staff, who told their services to help if the flight did not interfere with government traffic.

Communications were needed to relay weather and other information to the Voyager crew and to monitor the crew's condition. The on-board weather radar had a maximum range of about 200 mi.—useful for steering through local thunderstorm cells but inadequate for strategic planning.

In one instance over the Atlantic, the on-board radar suggested the best way to avoid some fresh thunderstorms was to turn right, but a larger view from weather satellite photos in mission control showed that turning left was the better overall course. This information was relayed via the high-frequency radio to the crew, which otherwise could have flown into a wide belt of thunderstorms rising to altitudes of 70,000 ft.

This portion of the flight also demonstrated the versatility of the communications network when HF transmissions were rerouted in several minutes from Ascension Island to Cape Canaveral after a power failure forced Ascension off the air.

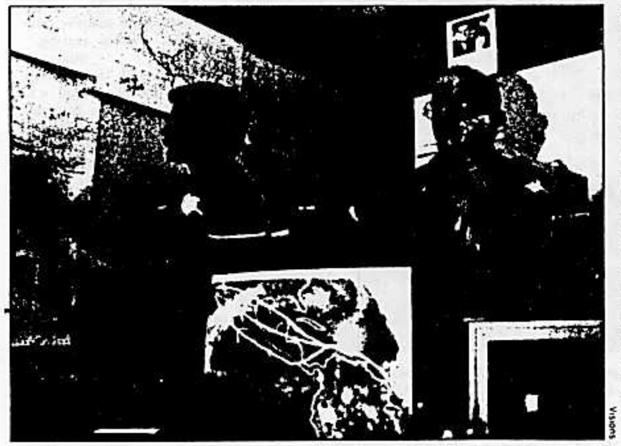
Mission control was able to enter directly the military UHF satellite network with a Motorola LST-5 lightweight transceiver and antenna pointed at either of the TRW FltSatCom satellites located at 172 E. Long. or 100 W. Long. Voyager also had an LST-5 on board, with a 1.5-ft.-dia. folding hand-held antenna.

LST-5 operations required two people—one to talk and the other to point the antenna at the satellite. Due to Rutan's size, he and the deployed antenna could not fit in the cabin rest area simultaneously, so UHF satellite communications were conducted only when Rutan was flying and Yeager was pointing the antenna. The satellite had to be at least 30 deg. above the horizon to prevent blocking the antenna's line of sight with Rutan's body or the engines.

Mission control entered the HF network via telephone lines to Vandenberg AFB, Calif., which is connected to the military and NASA communications systems. A variety of methods, including telephone lines, were used to connect Vandenberg to HF ground stations best suited to talk to Voyager. Voyager carried a King KHF 990 high-frequency radio, a 150-w. unit normally used on helicopters (AW&ST Aug. 11, 1986, p. 72). Special care had to be given to antenna installation since Voyager's nonmetallic composite airframe did not provide a good ground. The antenna trailed behind the left vertical stabilizer and emitted a generally north-south radiation pattern. An east-west pattern would have been better for communications during the round-the-world flight.

Some radio transmissions interfered with the autopilot, causing the aircraft to toss about.

Neither UHF nor HF communications was always reliable, for several reasons. HF communications depend on bouncing the signal off atmospheric layers, and this phenomenon is sporadic. The UHF satellite channel used by Voyager has fixed transmitter power shared by up to 21 users, and communications could drop out when power was shared by too many users. ☐

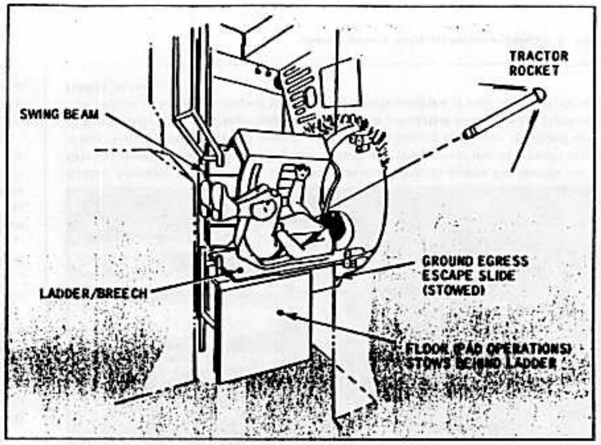


Visions

Voyager support crewmembers supplied current weather data and kept in close contact with the aircraft from the Mojave command center throughout the flight. Satellite weather imagery was displayed on digital processing system stations and associated screens.

Shuttle Escape System Given Tentative Approval

NASA has tentatively approved development of a space shuttle crew escape system using tractor rockets that would pull astronauts out of the orbiter's side hatch during gliding flight. Shuttle managers Dec. 23 ordered Rockwell International and other vendors to begin development of a blowaway hatch and the Upco tractor rocket system. Meetings are set this week at Kennedy Space Center to discuss orbiter modifications, and Kennedy could begin preliminary modification work on the orbiter Discovery by Jan. 13. Additional reviews of the system are set for Jan. 16 and the week of Jan. 19. The $50-million system may be implemented in time for the vehicle's first post-Challenger accident mission, and has the potential of being a pacing factor in the flight schedule.


TRACTOR ROCKET
SWING BEAM
GROUND EGRESS ESCAPE SLIDE (STOWED)
LADDER/BREECH
FLOOR (PAD OPERATIONS) STOWS BEHIND LADDER

Voyager Crew Uses Satellite Weather Data

Los Angeles—The use of satellite weather data by the Voyager ground crew made it possible to conduct the unrefueled, world-circling flight safely during winter months when the weather patterns normally would be less favorable, according to a project official.

Jack Norris, Voyager mission control technical director, said June through August would have been the best months to make the attempt, when the weather south of the equator was significantly milder and more stable. Information from a Digital Weather Image Processing System, however, enabled the Voyager team to guide the flight crew around problem areas last month.

"It's really the only way you could do what we did because we were literally able to see the weather all the way around the world," Norris said. The Voyager team at Mojave, Calif., comprising a half-dozen volunteers, tracked the aircraft with VLF Omega navigation data provided by the flight crew.

Norris said the trip was attempted when there was a Moon to aid the crew in spotting weather at night, but that the crew used infrared binoculars at night before the Moon rose in the sky.

Because of the time of year, the crew had to contend with weather problems during much of the trip, while the same route during the summer months would have encountered many fewer problems. The weather was more favorable the week the decision was made to begin the flight, but turned worse along the route the week of the trip.

Some of the worst encounters included navigating around typhoon Marge, being forced to fly near the air defense identification zone of Vietnam, crossing Africa when the aircraft had to climb to 20,000 ft., and more problems off the coast of Africa and off the coast of South America when Voyager was thrown into a bank of about 90 deg. ☐

Fairchild Space Wins JPL Topex Contract

Washington—The Fairchild Space Co. has been selected by the Jet Propulsion Laboratory to build the Topex/Poseidon ocean topography spacecraft, which is to be launched on a European Ariane booster in 1991 under the U. S./French mission plan.

Fairchild Space, Germantown, Md., is negotiating with JPL for an exact contract figure. It won the award over RCA and Rockwell International.

The Fairchild design incorporates a multimission spacecraft bus similar to that used on the Solar Maximum satellite, but with precise U. S./French altimeter instrumentation mounted on the forward portion of the spacecraft.

The satellite's mission will be to use a U. S. radar altimeter and an advanced French solid-state altimeter to obtain precise measurements of the ocean's surface heights. The vehicle also will carry a U. S. microwave radiometer to assist radar calibration.

The French contribution, in addition to its altimeter, will be a precise spacecraft tracking system used to help obtain spacecraft position data.

Space Station RFPs Delayed Until February

Washington—NASA will delay its release of space station hardware development requests for proposals by at least two weeks to allow time for senior station managers to brief members of Congress and Office of Management and Budget officials on the proposals.

Andrew J. Stofan, NASA associate administrator for the Office of the Space Station, said all elements of the station program were preparing to support release of the requests for proposals by about Jan. 20 when it became apparent the project needed more time to brief key individuals exercising station oversight outside the agency.

The earliest RFP release would now be Feb. 3.

Some managers in and out of NASA believe the potential exists for a longer delay, although Stofan disagrees.

He believes the specific program elements will now satisfy concerns of the House Appropriations subcommittee and others on life sciences development and the need to devote funding to support space science's role in the station early in its deployment.

AMORPHOUS ABSTRACTIONS

Guy Wicker

It is one day before Ishercon and detonators are on my mind, so I don't have a lot of time to write this. Back in college I questioned an article I read by a city police department bomb squad expert. The article talked about all the fancy robotic equipment they use to disarm bombs. It said there was no bomb they couldn't disarm. I proceeded to design a bomb that couldn't be disarmed. Then I ordered the parts to make it (minus explosives) and, like most of my projects, they are still sitting on the shelf.

This one is a more modest design. It will have pinball machine tilt sensors that will detonate it if it moves, and a crisscross detonator. The crisscross detonator has two detonators and if one of them is deactivated, it will trigger the other. Simultaneous de-activation must be performed in a flash (the time it takes for a flashbulb to fire).

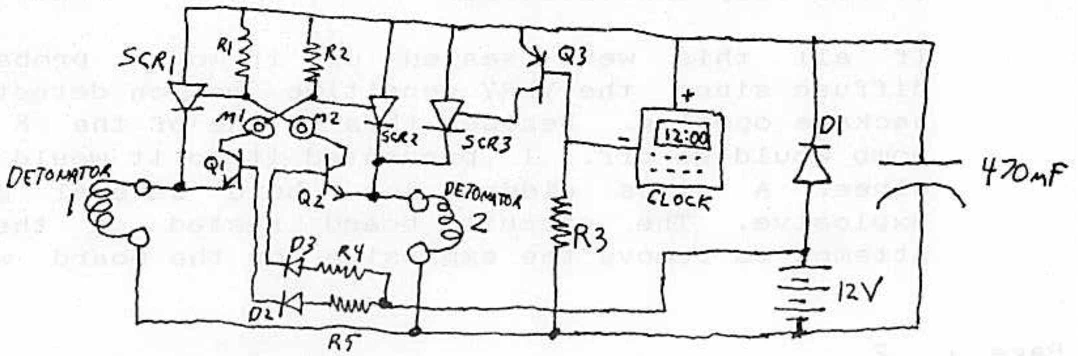
(7 days later)

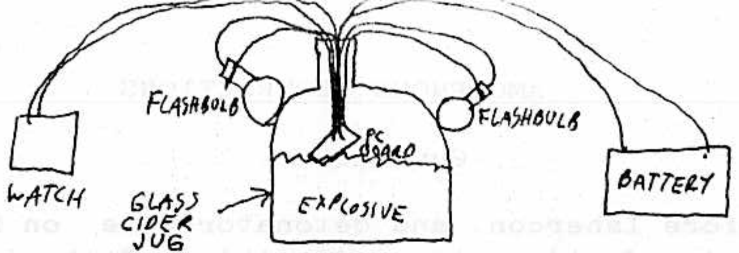
Ishercon was fun! Barry successfully diffused the bomb in an unexpected manner. Instead of attacking the electronics he attacked the flashbulbs. He injected water into tiny holes drilled into the bulb. When he cut the wires, the crisscross circuit succeeded in warming the water in one of the flashbulbs slightly. Next year I'm going to put the electronics on the outside and the detonators on the inside.

The only other bomb submission was Tullio's. It had a photo-sensor inside and Bomb Squad #1 was destroyed when they used a flashlight to look around. Bomb Squad #2 was more careful and determined a method to deactivate the clock, eliminating time constraint so they could figure out a god way to diffuse it.

A lot of people were interested in trying to build a bomb, but didn't have the time. So, to get all you potential terrorists started, here is a short primer on the subject: Bomb Theory 101.

There are 3 parts to the bomb which a bomb squad can attack to diffuse a bomb: the explosive material itself; the detonator; and the timing mechanism. There are several simple things the terrorist can do to prevent these things from happening. Inaccessibility is the easiest, though some access is required for the terrorist to diffuse the bomb if demands are met. Tamper detection is the second. Several easy electronic methods of tamper detection are: vibration sensing; light sensing; sound sensing; current sensing and voltage sensing. I used all of these except sound and light in my bomb. Tullio got them with light. Here is The schematic of my bomb.





There are 3 SCRs in the circuit. If any of them trigger they sent a lot of current through one of the flashbulbs within microseconds. I used Gates lead acid batteries and the actual current through the bulbs was 17 Amps when fired. Flashbulbs only require 250 to 500 miliamps minimum to fire if they aren't filled with water. The capacitor, C1, insures no Battery tampering. If the battery is removed or shorted, the transistors Q1 and Q2 will turn off, triggering SCR 1 and 2. Sue Carter suggested a gradual voltage reduction. In this case that would have worked. There isn't any true voltage sensing going on, since I wanted a quick and simple circuit. What could be used is a zener diode so that if the voltage went down to 80% of full value the transistors Q1 and Q2 would turn off. The motion sensors, M1 and M2 are pinball tilt sensors. They are ball bearings in a can. I had them tilted and any angular or vibrational motion would move the balls and momentarily break the connection. R1 and R2 pull up the SCR so this break, or a break by turning off transistors Q1 & Q2 will trigger the SCRs. The bulbs themselves are also in this path. If any bulb wire is cut that bulb won't go off, but the other bulb will be instantly triggered. With 17 Amps of current there is no way to cut both bulbs off simultaneously before they fire. You can, however, short circuit them. This takes them out of the path so they can be cut and removed. The bulbs are one ohm resistors. To sense something with that low a resistance would be tricky so I didn't bother. No-one could be sure that I didn't, and no one knew the bulb resistance was really that low.

The timer would have taken more circuitry than all the above stuff combined and I wanted to throw this together in less than 5 hours. Instead of designing it, I got the guts from an old digital watch I owned. It had an alarm clock function so I traced down how that worked. Conveniently, the beeper was a piezo crystal attached to the back plate. It had spring contacts to the watch guts so it was easy to stick two wires into the springs and get my trigger wires. The wires had 140 ohms between them when the alarm is off and they oscillate with .6 volts when the alarm sounds. This wasn't enough to trigger an SCR so Iamplified it with transistor Q3 and used SCR3 to fire the flashbulb. I had to insure that the clock wires weren't tampered with. It wouldn't be hard to make a 140 ohm detection circuit to do this, but It was even easier to just bias the transistor so that if the 140 ohms was cut it would detonate. If the clock wires were shorted together it would have successfully disabled the timer. Another detail was that this digital watch had a reset alarm button. I stuck a piece of tin foil in the contacts of another button to short it, thus disabling the other buttons. It was very unnoticeable.

If all this were sealed up it would probably be impossible to diffuse since the VERY sensitive motion detectors would detect the package opening. Besides this If one of the 8 wires was cut, the bomb would go off. I presented it so it would be very easy to cut wires. A glass cider jug held several pounds of simulated explosive. The circuit board rested on the explosive so any attempt to remove the explosive or the board would surely trigger the motion sensors. 8 wires, all about a foot long came out the top. The flashbulbs were glued onto the jug with silicone rubber cement so attempts to lengthen the detonator wires would require extra careful removal of the bulbs to keep the jug from vibrating. The watch and battery were only attached by the 2 wires going to each of them, tempting the unsuspecting to snip wires.

As for the rest of Ishercon, a 6 Mac computer room was kept in constant use due to a network game called Maze Wars, where all 6 users attempt to destroy one another. If you left the computer room to go downstairs you would get shot by yellow rubber bullets. The fireworks display went well and no arrests were made there, but Tullio was arrested for some sort of subversive activity at the 60's party. All in all, it was a pretty violent time. Maybe they should have a more strict weapons policy next year: no projectiles allowed; bullets must be peace bonded.

Mailing Comments:

Barry - Next year its gonna be a lot tougher!

Deadwood Tribune

Blame it on: Sam Paris
P.O. Box 41067
Chicago, Il 60641
Tele. # 312-685-7768

Since my last submission, a spaceship has exploded, a nuclear reactor has melted down, the U.S. attacked Libya, a canoe sank with all hands on the Red Cedar (fortunately, the hands are OK, along with the vaudeville act they were attached to), Lyndon LaRouche got two candidates on the state Democratic ticket (they lost) , the warranty on Reagan's Teflon expired, and Andy Anda got engaged. Oh yes, I got divorced, moved, and got a new job. "It's been a quiet year here in Deadwood... "

Back in my first submission I speculated that my (then brand new) marriage would be "interesting" . It was.

Looking back over two years, I find it hard to think of anything Mary Ann and I agreed on. We often argued, at great length and volume, over trivial matters. On important matters it was simpler to act first and ask later. Two years of this was a century too many. I know of nothing as boring as a litany of complaints about ones ex-wife, unless it's an l. of c. about one's ex-husband. Masochists wanting to know the gory details can corner me at a convention sometime. Bring plenty of NoDoz.

Of somewhat more interest is the period surrounding the divorce, and the divorce itself. I told Mary Ann last January that I wanted a divorce. We went through a rather teary discussion, and I got her to accept the idea. Over the next day or so ,she got less and less interested in seeing me around, so, feeling that discretion was the better part of survival, I bugged out... er, went to Michigan for Confusion.

I don't remember a whole lot about the con except feeling sorry for myself. A couple of people there were kind enough to let me cry on their shoulders, of those who will read this, special thanks to Barry Gehm and Bonnie Jones. You helped a lot.

When I returned To Chicago I found Mary Ann in an emotional shambles. She had told her parents about my plans for a divorce Sunday afternoon while I was still away. Her parents, devout Irish Catholics, blamed her for my

decision! I gather that Mary Ann's mother told her that she had ruined both her own and her parent's lives. There was some talk of getting Mary Ann to enter a convent to redeem herself. At some point in the shouting match this idea provoked, Mary Ann's mother asked her,"What decent man would have you now?".

I found myself in the peculiar position of being Mary Ann's only source of emotional support. It's not easy to do this for a person you have just, in effect, told to go to hell. Fortunately, her cousin John was sympathetic and managed to talk a little sense into her parents. Also, after a few weeks she began to get in touch with some old friends she had lost contact with since our wedding, and they helped her over some of the humps.

Still, it was a difficult time for us both. Have you ever spent a month talking someone out of killing herself? Try to avoid it if you can.

The legal process of getting a divorce is unbelievably complex, even with an amicable separation like ours. We had already divided the property among ourselves (I got to keep my shoes) and there were no children, but there were reams of paperwork to fill out, bank accounts to be untangled, credit cards to be minced (Mary Ann shops when she's depressed. I'm afraid I rather high handedly removed her ability to run up large debts), and guns to be disassembled (I own a target pistol and a shotgun, it didn't seem like a good idea to have either functional right about then).

There was one other complication to worry about. Mary Ann is Catholic, and I wanted to be sure she could get an annulment. So we consulted one of Mary Ann's relatives, a priest, for pointers on the best way to proceed to better her chances. Oddly enough, we were told that the best bet was for her to sue me for divorce rather than vice versa. This was confirmed by a counselor at Catholic Charities. Neither source could tell us the reasoning behind this advice, just that that was their experience dealing with the Chicago Archdiocese.

So the partner who wanted to breakup wound up being sued for divorce by the partner who wanted to stay together.

Illinois has a no-fault divorce law, but we couldn't use it because it would have made the annulment harder to get. So I had to agree in court that I was cruel and unusual, or something, to Mary Ann.

We got the divorce May 6, a little more than two years after our wedding. It would have been sooner, but her lawyer was on his honeymoon.

On to cheerier things. Cast adrift as I was, I needed a place to live and a

job. Andy Anda and his mother, Joy, had an extra room. They offered it to me. One down. A few weeks later, I found a job as staff physicist at a company called Ircon.

Ircon makes infrared pyrometers, a technology I knew almost nothing about. I got the job largely on the basis of my experience as a technician at NiTec, an image intensifier company. Both products use infrared light. That they otherwise have nothing in common was a fact I sort of glossed over in the interview.

That was more than half a year ago. I have since learned a little about pyrometry, and a whole lot about the the wisdom of documenting engineering work.

About 6 months before I started work , Ircon introduced a new line of microprocessor driven pyrometers. (For the uninitiate, pyrometers are temperature measuring devices, widely used to control high temperature industrial processes like glassmaking, steel forging and semiconductor processing. The ones Ircon makes work by measuring the infrared radiation given off by hot objects. They are especially useful when you would rather not touch the object in question.) Rather than simply adapt existing products to the processor, they decided to do a complete redesign in order to eliminate some longstanding problems. Along the way, they designed in a whole new set of bugs. An awful lot of this work was done by my predecessor, a man who did a fairly decent job, but believed that the final drawing was explanation enough for anybody.

The options package on this product (The Maxline, for those of you who've seen our ads), includes about 6 different wavelengths, 4 resolutions, 3 control options, half a dozen or so temperature regions, and so on, ad infinitum, for on the order of half a million or so combinations. Most of them probably work. On the other hand, we haven't even come close to trying all of the possibilities, so new problems arise frequently. These are usually minor and easy to fix, but occasionally I find that my proposed changes resurrect an old problem that the new design was supposed to eliminate. It would be awfully nice to have some notes telling me why some choices were made instead of others. (Yes, I'm making such notes for myself and my successors)

There is a more serious problem: There seem to be no reliable suppliers of some kinds of infrared detectors anywhere. Since I've been at Ircon, 5 separate suppliers have shipped us loads of junk detectors. Sometimes the problem is easy to spot, like low sensitivity, sometimes the problem is more subtle, like noise levels that suddenly increase by a factor of ten. That last

problem showed up only after the pyrometers had been shipped to customers. It went away again when the pyrometers came back to our service department. It took us a week to catch it happening again. It took longer to convince our supplier that his detectors were at fault and to devise a test to screen out detectors with this fault.

I've learned a lot more about IR detectors than I thought there was to know 6 months ago.

Mailing comments: I don't have a set of last year's apas with me, so I can't really do all the mailing comments I'd like. Sooo.......

General Relativity, eh? Einstein says you can't tell the difference between an acceleration and a uniform gravitational field, so slowing the car just changes the direction of "down" in the car. Down will move forward, so the balloon will move backward in order to stay "up". (I hope I've remembered the problem correctly, the balloon *was* in a car that was *slowing* ?)

New folks, welcome!

New schedule, welcome! Even though it makes me feel guilty twice as often, I like the new schedule. I hope it continues to work out.

Myself: Looking over my last contribution, I see that in my article about other people's illiteracy, there were a ridiculous number of spelling and grammatical errors. These must have been added by the Xerox machine.

I'm writing this at Ishercon,and all around me, people are playing games and having a marvelous time, so I'll sign off now.

another member, known as Valli Hoski, 228-D South Maple, Oak Park, IL 60302 and (312)383-3864 returns to the fold of ApaTech just in time to spend the holidays with her longtime friends. December, 1986.

+--+

Since we've no place to go, let it snow, let it snow, ...

December, that Festival of Lights for all cities, has arrived and with it the penultimate reason to return to ApaTech: write or be dropped. So, in the midst of the twinkling chill of Chicago, being serenaded by Christmas music and moods, I bring a few gifts of my own.

Chicago gives me two great joys: riding its multitudinous trains and exploring its microcosmic neighborhoods. From commuter station to rackety elevated platform, you can ride the rails to traditionally wealthy towns, acres of suburban flatlands, lively pockets of European neighborhoods filled with recent emigrants, and turn of the century villages built in the uniquely American prairie-style. (Yup, it's the really Wright stuff).

During the past year, I've come to write a 'travelogue' series of sorts on jaunts in the Windy City for our local apa, WindyApa. I'm including some of the best of the year here for your winter reading and I think you'll enjoy these views of Chicago.

Where are the mathematical derivations? This is Apatech after all!

Yes there is some original news in here for ApaTech as well. Mailing comments hopefully will follow at the back of this zine. But short news of my recent doings...

For the past year and a half, I've been with the MIS consulting firm of Booz, Allen & Hamilton, where I am responsible for user training for a customized claims processing system we are designing and installing for a government agency. This year I was promoted to Associate (manager) which is Real Good News. And that is all I have to say about work.

As some of you may recall, I've been taking courses for the past few years. When this term is over, I will have completed my fourth class in Italian and my algebra course. I'm thrilled with meeting my goal of taking 2 years of college level language courses and am reasonably fluent in Italian. Now, I am slowly building my math proficiency, and am only 1 course away from taking calculus. Why, you ask, am I still taking courses, when I have 3 degrees already? Well, I decided that even with my liberal education, it was a Good Thing to have 2 years of a language and to close up my math gap. Even though I develop EDP and technical training professionally, I am not a math or C.S. major (maybe I really want to be an engineer when I grow up, I dunno). So I am filling in the gaps in my knowledge, now that I am old enough to know how much fun learning new things can be. And that is really it, I am having a great time. Chemistry might even be next.

Here is a view of Chicago that is really in keeping with the traditions and warmth of Christmas...

The Poland and Ukraine in the heart of Chicago

Found two more very special neighborhoods in Chicago. But my very favorite is in the last two paragraphs. More reasons to love this city and some of its special people.

How to get to Cracow: go north on Milwaukee Ave. from Grand, past the barrio neighborhoods. Cross Diversey and you are in Cracow. But you don't need a border crossing to get your visa checked. The signs, newspapers, stores and crowds will all tell you that you are now in Poland. Stroll into the Staropolska deli/restaurant and survey all the fine delicacies. Sausages of many makes and stuffings spread in their casings. Shelves of Krakow (Polish for generic?) jellies, soups, and other bottled wonders. Pierogies (meat ones, possibly as good as my grandmother's ones?) hiding in the frozen case in the corner. Very nice ham can be found in the long rolled casing on the top meat counter. But wait until you've left the deli to eat it.

Try not to look too touristy as you purvey the goods and the clientele. Grandmothers and a younger generation as well, murmur about you in a tongue you have only heard your parents speak. A funny sort of feeling creeps up your spine. What was that you once read, "a stranger in a strange land"? This is Chicago, right? Then why do you think you've stepping-stoned into a Warsaw neighborhood? What is this conspicousness you feel? Welcome to being a tourist in your own hometown.

This is obviously one of Chicago's ethnic neighborhoods, surprisingly full of a newer generation of emmigrees. The old Polish enclave around Milwaukee has moved up to the Diversey area and brought younger members along. Here is the home of the Copernicus Center, several Polish dailies as well as the stores and restaurants that make up any cozy neighborhood.

Several restaurants seem good places to try the local fare. The Wigry restaurant has a deceiving buffet and salad bar, but do not fear, the pierogies and such promised on the menu are very real. Meat pierogies that do honor to the memory of my grandmother's make a very nice dinner. Meal and price size are similar to that of the Plaza (that Berwyn Bohemian restuarant favorite of Rich Rostrom's and myself), around $5-8 for a full dinner, with soup, appetizer, vegetables, coffee and dessert. This seems to be an excellent substitute for the Detroit Polish restaurants I left behind in my old hometown.

Now let's just go a bit further west to the Ukraine.

Drive up Oakley, promised as a scenic route on the Trib map of Chicagoland, pass the barrios once more and you come into a well-kept neighborhood of brownstones and houses. Wait a second, you say, we are on the west side of Chicago, just south of Wicker Park, what is this? No, this is not Bridgeport, this is the Ukraine.

Churches, you will see a lot of churches here. Especially ones with names you cannot pronounce or perhaps not even read.

Here is Ukrainian Catholic St. Nicholaus' with the domes. "Modelled after St. Sofia in Kiev but with fewer domes" say the Chicago guidebooks. Restored in the late 70s, it is a blue Ukrainian Easter egg on the inside. Gorgeously breathtaking, with gilt and blue wall ornamentation, sweet light from the domes. Tantalizingly familiar since it is Catholic, but with the screens and other exotic furnishings of the Eastern rite faiths. One of the truly beautiful churches of Chicago.

Maybe all of two blocks away is the church with the gold dome--you can't miss it. (The names are written in English and Cyrillic letters, but I can't recall nor pronounce them.) Although St. Nicholas' looks more conservative from the outside, this is the newer and more conservative parish of the two. Founded in the 1960s by members of St. Nicholas' who disagreed when St. Nicholas dropped the old calendar of the Eastern faiths and observed the holidays according to the western dates (again, courtesy of the Chicago guidebooks.) This is not a plain and simple church. A stunning mosaic proclaims Christ's face and glory for all to see on one side of the church; perhaps the interior is equally stunning, but it was closed at the time. If you get inside, let me know.

Both churches are eloquence speeches of faith, hope and a desire to display one's gratitude to a higher deity. Both are inspiring, with one creed certainly as monumental as the other.

A small Russian Orthodox church, from a town on the steppes, is just a few blocks away. Humble in size, Holy Trinity Cathedral seems transported from a Russian peasant settlement. Impatient horses should be stomping with steaming breath tied close to its front doors, jangling their harnesses in the cold wind sweeping from the winter plains. The doors will swing open, heavily robed and coated people taking leave of their priest for the evening. Flashes of ruby and topaz light pour out from the church's interior as the incense is carried on the wind, past the priest lingering at the door. Blessings and greetings abound in a rumbling tongue, horses, carts and riders take to the evening darkened roads for home.

Blink your eyes and you are back, standing on the west side looking at a church out of another time and place. Brought here through Louis Sullivan's execution and skill, this is a Russian Orthodox church built for a congregation of Russian country people. This is also a very special place, a very special feeling given by a people and their heritage to their god and their culture.

First, a reintroduction of myself to all the newer faces in ApaTech since last year...

Yes, I am truly a ValliGirl, being named Valli Marie Hoski (after my father, who was a terrific guy, by my mother, who is unique in her own right)), a native of Detroit, 5'4", brown eyes and hair, dressing occasionally preppy (I like wool blazers and skirts but pragmatically admit to wearing permapress shirts) and occasionally Bavarian (they really have nice wool and their women's sizes allow for real hips!). I have been more than an occasional student at Michigan State University, Purdue University, Indiana University, Wayne State University (Detroit), University of Illinois at Chicago, Triton College, Loyola University of Chicago, and Loop College (Chicago); and yes I do have degrees, three in fact, from the first three schools (MSU, PU, IU). Also, I have Joachim Schurmann as a husband; he is rather continental, being of German parents and having grown up in Milan. We have no children (yet), no cats (not anymore), no dogs (yet; never a poodle or other yappette) and no fish; we do have a house (2 story brick townhouse in Oak Park), a car (Renault Alliance), a rented VCR (I am afraid to own one) and a Teddy Ruxpin (my birthday present who sings so sweetly with Bill Higgins' voice).

Architecture and its history have been known to be interests of mine. So are art, history and travelling in general, to Europe in particular (having inlaws there does help). On a typical 2nd Saturday of the month you will find me giving tours of the Frank Lloyd Wright Home and Studio in Oak Park. And oh yes, I love trains, all kinds, from clacky rapid transit through smoother commuter trains to elegant long-distance liners. On other weekends you may find me (and an errant husband or friend in tow) exploring some strange Chicago or suburban neighborhood or other unique attributes, usually involving train travel. If I remember, have time and am motivated, I even write these "Windycity Tours for the Native / Naive Knave" for the procurement and enjoyment of the apae audience.

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BERWYN, ILLINOIS 60402

And now, maybe the actual mailing cts. These are being done in "real time", folks. This means its me and my trusty, humungous IBM Selctric typer (sans mag interface facility). I've returned to "low tech" since I am home today studying for a math final and we don't own a PC. *gasp* Yes it is true we have not succumbed to high tech in the home, completely yet. But this means there is not convenient way to go back and edit. Enough of the natter, on with MCs.

Exploding Cathead Cover (12/86) It looks terrific. Does the cereal taste terrific too? ~~Guess we'll find out at this year's Ishercon.~~ (Ah the return of the strike-outs. I haven't figured them out on MultiMate yet.) So how long did this artwork hang in the Isher kitchen before you used it?

ToC See, although late, I actually didn't minac out.//Who stuck the Shuttle stickers in this ish?//I do think that the January deadline should be in Kazoo, rather than the west coast, since many of us will be in Kazoo. I will mail this in good faith that the PS won't lose it with the holiday mail.

Sheila Re yr uncle in ND with the "Tall cows": living in the midst of that history-changing equipment would make me very nervous and pessimistic. As if I'm not already.//Re rug rats and yr facts: gee, now ApaTech is turning into the "family apa". That used to be WindyApa in Chicago. Why don't the men n ApaTech have much to say about children and that kind of stuff?

Guy You ought to see, if you haven't already, Bentley's moose with the cutesy sayings on his Mac. Stuff like, (when you haven't press Enter for 20 sec.) "Wake up now", "What are you doing", "Hi there", "Get back to work"; there are better sayings too, but I don't recall them. When you try to turn him off (he pops on the screen at a variable rate) you get pleadings such as, "I promise to be good", "Won't you miss me", etc. A cute touch.//Re Houghton Beserker: I had to read it twice. First time I read "Houston" and went huh?...If I am around and have vacation time then, Joa and I might be interested. I haven't been back to the UP in years, since all my family vacations were up there, I know it's refreshingly piney and woodsy in the summer. Just try not to go at the height of the black fly season.

Guy Re yr view of America being cocky and insecure at the same time: we think we are at the cutting edge technologically and research-wise, yet we have a massive inferiority complex when it comes to our history and culture. Even with the profound impact of American art, culture and societal structure/attitudes on the postWWII western world, we still look to European traditions, cultures, history as being infinitely preferable and more worthy than ours. The irony of this is that America is viewed by Europe as naive and perhaps culturally/historically flat but a place where success can occur rapidly based on personal initiative, discovery and talent; there are fewer barriers here due to long-standing excuses of historical precedence, social roles, etc. Even with its strong unions, America pales by comparison to the European unions; pales in terms of union solidarity (when, except for the auto companies, is there ever a truly national strike here?) but also treatment of the individual worker, unionized or not (GM announces it will close 4 plants, layoff 25,000 workers and it's tough luck buddy; the unions or the government don't/can't/won't stop GM or assist the new unemployed in any substantial way.) By contrast, the unionized European worker has much more of protection and more guarantees: of a job, adequate housing, food, medical coverage. But the price is a tighter job market, more stifled advancement and fewer flamboyant success stories.//And here I am, the humanities undergrad major, whose speciality is modern European history and art. America's development since the '20s as a world power is gaining recognition for her history, philosophy and identity within the country. But we also tread that fine line between national pride and international arrogance; the true state of the modern world includes the USA, the EEC 12, and the USSR, China, and others.

Guy (cont'd) Our focus seems to only look at the USA and USSR, and minimally treats the EEC 12 and other countries. (For this reason, my weekly news magazine is the Economist, where I can actually read about events in Europe and the "third world".) Hopefully we'll solve our insecurities without blowing up the world doing it; the same goes for the USSR.

Rod Re typing something faster from scratch: that's how I do my fan/apazine stuff all the time. Now I know that a perzine doesn't compare with a novel, but even in college I had difficulty writing out drafts. Usually I typed one, retyped it several times and handed the paper in. Using this typer is reminding me of its disadvantages. I think faster than even the Selectric can keep up with, and I keep having to go back to fix skipped letters, etc. The PC is closer, but its keyboard buffer helps out as well.

Roxanne Re south of the Mason/Dixon line: I really liked Virginia when we visited it last year. Monticello was a beauty; one of the most rationally and perfectly proportioned buildings I have ever been in. The entire state seemed so graceful and well-balanced. Then I later realized that it had been part of the confederacy during the Civil War. My respect for its prosperity strongly dropped when I realized what it had been built upon; much like my respect for modern Germany's prosperity. But then again, children aren't supposed to be punished for the crimes of their parents, or something like that.// Does everyone in Dayton talk funny like they do in north central Indiana? There, it seems that everyone wishes they were either in or from Kentucky or Tennessee; just 90 miles south of Chicago, in Lafayette Indiana you get the "yewall" from the clerk at the Osco or Jewel. But then again, north central Indiana is a strangeness all to itself.

Greg Gee what a pretty zine.//I think that it's really nifty that Bill Higgins and Barry Gehm will get to do their show together for southern cal fandom. You are a real sweetie for making it happen. What will southern Cal do when it's confronted with real wit and brilliance?

Tullio Tullio? Tullio actually in ApaTech? I can't remember seeing you before...but I have been known to be wrong.//Come stai, mio amico? Ieri sera ho fatto un esame per la mia classe d'italiano; spero che fosse la mia classe ultima con quella professoressa. Non ella mi piace molto. Ma, adesso, ho studiato l'italiano per quattro semestri. Va bene, no? Tanti auguri per questo Natale.// Re Detroit being better off blown off the map: what is this baloney? I known of a far better candidate: Gary; how bout Joliet? Remember, a goodly chunk of our fair friends are from Detroit, or have family there: Marty, Keith, Renee, to name a few.//Besides where would I get my loose hamburgers? Shudder at the thought of those withdrawl symptoms.//Re yr cat in Italy: the cats I have seen in Rome, Genoa and Venice put most of any others I have seen to shame. Now, these Italian cats were real cats: plump, self-sufficient and self-possessed. Maybe it's something in the Mediterranean fish. But they were real beauties, from the traditional Egyptian looking cats to the mixed tortoise-shell to the greys. I wanted to take one/several/many home but that wouldn't be possible. They ~~are too Italian and~~ would hiss and spit at the indignity of American domestic life.

Donna You forgot one other ingredient of fannish parties, even G_T ones: hugging. We hug each other a lot more (hello/goodbye/how are you doing etc.) than people do at nonfannish parties.

Alice Thanks for your quasi-beserker in Dec. (13th). It was a nice warmup to the holiday season; and of course, nice to be with everyone again.

Susannah&Dave Thanks for yr news of Marlene! I really enjoy reading about her. Out of room, but did also enjoy the rest.

TECH0011

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** TECHNOLOGY FOR THE MENSCH **
*** ***
*** by Joachim Schürmann, KA9WGP ***
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228-D South Maple, Oak Park, Il. 60302-3008

PREFACE

It's now just about a year that I have promised Donna Proni to write a zine for APATECH. I finally got my priorities straight, pushed all those issues aside which are always clamoring for immediate attention, and decided to get around writing this zine. I must also thank Donna for her patience. Not once did she remind me of the promise I made. But I didn't forget. Here we go...

BACKGROUND

Since I am now the new kid on the block, I will first of all introduce myself. My name is Joachim Schürmann, with the funny dots over the "u". I am very proud of these dots since they make my name different and difficult to spell. It took me some time to learn that the "u" with umlaut is actually available on most Personal Computers and word processors. It is the ASCII character Dec'129' which I insist on entering through the keypad every time I spell my name on the PC. My secretary has figured out a way to spell the "ü" on the Wang word processor, which of course has improved our working relationship, but that is another story...

I was born of and brought up by German parents. Thus I am German. I lived for about 25 years in Milan, Italy. Therefore I also speak and think Italian. I have been in the States for approximately five years. I came here as a single gentleman on a temporary intra company transfer with my then employer, a large consulting company. Meanwhile I have changed employment and marital status. I am now an Information System Auditor with a large Midwestern bank. I am also married. My spouse is Valli Hoski: I am sure this name is known to some of you.

OTHER THINGS

Why do I think I might like to be in APATECH? First of all I like to read it. Valli is a member and therefore sometimes I get to see it. I also know some of the members personally and have discovered somewhat of an intellectual affinity. But most of all I am part of the big crowd of thinkers and tinkerers. I only never realized that there was anything special about it until Valli pointed out that a large part of mankind functions differently.

Having grown up as a foreigner in a foreign country, I am used to hearing shortwave radio. As a matter of fact for me "radio" is practically synonymous with "shortwave". The only way to reliably receive broadcasts from Germany while living in Italy is by shortwave, and thus we regularly listened to shortwave. I carried this habit with me to the States and also expanded the scope to other foreign stations. When I met Valli I did not own a television set but a powerful shortwave receiver. I suspect I still could do without TV and FM radio. Meanwhile I have realized that listening to remote radio stations on shortwave is called DXing (DeExing) and is viewed as being a rather specialized hobby.

I also have done my share of tinkering. I still do it, but on different scale. My father is an engineer and thought it was important for his son to understand the physics of the world at an early age. Therefore I received a lot of building sets for my birthdays and Christmases. I must have been somewhere between age 15 and 18 when I build my first AM radio and actually made it work. It was a beauty with one low voltage pentode and one transistor. The pentode was heavy on the batteries and the transistor didn't live very long, but it was a thrill to hear it work. Now, everybody (or almost) can build equipment by assembling items following a simple switching scheme. It used to bother me that I did not fully understand what exactly was going on inside my contraptions. They worked, so what? I changed that real fast when we purchased our summer home in Germany but did not have any radio (nor TV!!) there. We were planning to stay there for eight weeks and after one week I was already bored out of my mind. Somewhere during this time I rigged an AM receiver using a semiconductor diode (which I had) as a detector, a bunch of capacitors and an HF coil (which I found) for band pass filter and the amplifier stage of an old Telefunken tape recorder (which I scrounged) to amplify the signal. Local reception only, but it worked. Big thrills of a bored mind.

College and business took their toll of my time. My tinkering slowed but never really stopped. For years I had another project on my mind: growing plants artificially. Here and there I picked up bits and pieces in literature, had a lot of theories but never managed to test any practical application. It also took me some time to find out that my idea, although certainly unusual, was not at all new to the world. It even had a name: Hydroculture or Hydroponics, but that was before I started reading Science Fiction. Did you ever notice that there are industrial applications of Hydroculture? Believe me, there are. There a quite some chances that the pale green lettuce or the unblemished salad tomatoes that you bought at your local grocery store were grown that way. However, hobby applications there are very few.

After my wife and I got married and we bought our current house in Oak Park, I finally had enough basement space to run some Hydroponics experiments. Thus I spent time in libraries to study details, build racks, found sources for my equipment and finally got something going, but it was a truly long way since Hydroponics is certainly not a popular science. Most of the literature I managed to find described the industrial approach: I was not planning to mix pounds of nutrients to serve a multi acre area. Over time however I started to get things right. When I had figured out the essentials I even found sources for hobby size chemicals, but that was well into the experiment.

Growing Hydroponics requires good control over the water acidity. Therefore, getting the acidity right was one of my first projects. Determining the pH value of a liquid is a fairly easy job with Nitrazine paper. The Oak Park faucet water was way too acid. Now what? The literature suggested to add lye. Now where does one find lye without dealing in industrial quantities? Drano, naturally; good, old, reliable Drano. It neutralized the acidity just fine, but my beans still died. Valli loves to refer to this experiment as the "day her husband killed the plants with Drano", but I claim they would have died anyway since other factors weren't right either.

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** TECHNOLOGY FOR THE MENSCH **

*** ***
*** by Joachim Schürmann, KA9WGP ***
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After about a year of trying, I did seem to get things right. My pride are three radishes which I grew from seeds to flower under totally artificial conditions. Beans and lettuce worked out fine too. The lettuce was definitely edible, we tried it. Other plants did not work out so well. After I learned how to grow plants "in vitro" I stopped doing it. Buying vegetables at the grocery store may be less rewarding, but it is definitely more time efficient. It is cheaper too. By the way, I do have some equipment to give away, including a high pressure sodium(?) lamp with adjusted spectrum. Apply within.

Lately I decided that I wanted to get some more into shortwave communication. Rather then being only on the receiving end of the transmission I wanted to do some transmitting myself. The key word is: Ham Radio. Therefore, during the last four or five months I spent a significant amount of my (and Valli's!!!) free time to prepare for my ham ticket. I am now KA9WGP, Technician, but I am not on the air yet. I still have to get equipment. I expect to be on the air shortly after Christmas or the New Year.

In this zine I have spent much of my effort introducing myself. Thus I will only add the following:

1. A commented excerpt from my DX log telling you when and on what frequencies I received what stations. All times are given in UTC, which, for the DXers, is nothing more than a complicated acronym for Greenwich Mean Time. Most stations are regulars. Given the right ionospheric conditions, you should be able to receive them every day in North America at the times indicated. Ionospheric conditions are never ideal, so the challenge is to catch the stations while they can be heard. If you are interested, just try!

2. Transmission times of a selected shortwave station. I will publish times and frequencies of the English service of Radio Deutsche Welle. For those of you who speak German or have German speaking relatives, I will also add times and frequencies of those portions of the German service that can be easily heard in the United States. This station is less posh than BBC but nevertheless one of the strongest. A safe and interesting bet for entry level DX listeneres. It can be heard under almost any ionospheric conditions.

***** KA9WGP ***********************
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********* Excerpts from my DX log *********
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***** 1 of 2 ** December 1986 *****

Location is 41,53N 87,47W. Equipment is SONY ICF-2001. Antenna is outside wire antenna.

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station: VOICE OF FREE CHINA location: Taipeh, Taiwan
language: English frequency: 5985kHz
date: November 17, 1986 time: 0350 - 0400 UTC
quality: RS=58
comments:
A station with truly oriental flavour comes in amazingly strong. Interesting English news. Also language lessons for the Mandarin(?) student. English probably from 0200 to 0400 UTC.

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station: LA VOZ DE LOS ANDES location: Quito, Ecuador
language: German frequency: 9860kHz
date: November 20, 1986 time: 0600 - 0630 UTC
quality: RS=46
comments:
A real surprise. German spoken here. I listened into transmissions beamed to Germany. The news are "different". Where else would one be appraised of the planned versus budgeted banana harvest of a South American Republic but on the 500kW beam of HCJB - The Voice of the Andes? This is no joke. Listen for yourself. To be fair I must mention that the international news are generally pretty good. Probably vintage Reuters.

HCJB is operated by the "World Radio Missionary Fellowship, Inc.", but does not come across as overly religious. There are transmissions in many languages. I caught HCJB in English on 9870kHz where it supposedly transmits from 0030 to 0700 UTC.

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station: LA VOZ DE NICARAGUA location: Managua, Nicar.
language: Spanish frequency: 6018kHz
date: November 20, 1986 time: 1215 - 1230 UTC
quality: RS=34
comments:
Coming amazingly strong from a 50kW transmitter in Managua. Rather local station. No international flair nor subtle propaganda. Simple party line. How is Mr. Hasenfuss?

Voice of Nicaragua also broadcasts in English, supposedly on 6100kHz, once a day at 0400 UTC. Didn't have the pleasure yet...

***** KA9WGP **********************

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********* Excerpts from my DX log *********

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***** 2 of 2 ** December 1986 *****

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station: RADIO MARTI' location: Greenville, USA
language: Spanish frequency: 11930kHz
date: November 22, 1986 time: 1620 - 1635 UTC
quality: RS=59
comments:

Great quality - small wonder. This station is operated by Voice of America, USA's (Anti)Propaganda network. Transmission is directed to Cuba, but VOA's signal can easily be picked up elsewhere in the States. Radio Marti' uses large amounts of the great capitalistic persuader called music; decandent music, that is. This makes it worth listening to. Bruce Springsteen cubano. For news I rather recommend your local evening news.

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station: RADIO HAVANA location: Havana, Cuba
language: English frequency: 9739kHz
date: November 24, 1986 time: 0050 - 0110 UTC
quality: RS=59
comments:

Actually broadcasts on 9740kHz, but reception was invariably stronger on 9739kHz. The true counterpoint to Radio Marti'. Strong medicine. Should be taken in small doses only.

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station: VOICE OF SOUTH AFRICA location: Johannesbrg,RSA
language: English frequency: 9615kHz
date: November 26, 1986 time: 0211 - 0230 UTC
quality: RS=48
comments:

From 0158 to 0256 UTC in English on this frequency. Also on 6010 kHz, but weaker, approx. RS=37. Much news and information. Nice complement to local news about "their" point of view. Rather intelligent broadcasts. Do you want to know the "real" reason for Barclay's divestiture in South Africa? Are you interested in learning about "shadow franchises"? For this and more tune into the Voice of South Africa.

***** KA9WGP ***********************
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*********** A selected DX station **********
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***** 1 of 1 ** December 1986 *****

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name: DEUTSCHE WELLE

address: Deutsche Welle
Abteilung Hörerpost
Postfach 100444
D-5000 Köln 1
WEST GERMANY

note: Deutsche Welle has monthly program flyers available. To get on the mailing list simply write to the address mentioned above. Listener reports are typically honoured by QSL cards. For consistent listeners there are small perks and incentives like calenders and technical flyers for Christmas. Deutsche Welle also welcomes monitors: registered individuals which consistently and over a long time send in reception reports. These individuals receive additional rewards.

English programs for the USA:	0100-0150 UTC on kHz:	6040 6085 6145 9545 9565 11785
	0300-0350 UTC on kHz:	5995 6045 6185 9545 9565
	0500-0550 UTC on kHz:	5960 6120 6130 9690

German programs for the USA:	2200-0547 UTC on kHz:	6100
	0000-0300 UTC on kHz:	9640 11750
	0200-0547 UTC on kHz:	6085 6145
	0300-0547 UTC on kHz:	9605
	1200-1400 UTC on kHz:	15275
	1800-2200 UTC on kHz:	15275
	2000-2200 UTC on kHz:	15355
	2000-2120 UTC on kHz:	17810
	2200-0000 UTC on kHz:	11750

LIFE AS A GLUEBALL IS PRETTY STICKY for ApaTech 47 by Kiran Wagle.

There is nothing like the pressure of a deadline passed to cause one to produce. I have been so busy with school this semester that I haven't had time to breathe. In addition to the usual physics curriculum (Quantum and Thermodynamics) and Numerical Analysys I have been studying Classical Greek and Music History to fulfill requirements. The music course was an interesting challenge, as I neither read music nor sing nor play an instrument. Not being one to do things by half measures, and having been bluntly informed by the department chairman that my prior knowledge of classical music would cause me to become bored in the standard "music appreciation" course, I bravely registered for the 300-level, 3-semester sequence for students in the music school. With a bunch of music majors pushing up the curve, I was unsure of my ability to achieve a proper grade. But some of those music majors were scoring less than 50% on exams on which I, a lowly math/physics student, was scoring 90%. That says quite a lot about the state of the average college student. When a person with no qualifications can outperform those who choose to make the subject their life's work....I tend to get more cynical every day.

Last year, when I didn't need it, quantum mechanics seemed easy. Now that I need to know it, it is difficult again. I suspect there may be a Law of Nature hidden here. In the spring I shall be working on the other half of my degree, with Algebraic Topology and Real Analysys (which is Measure Theory in disguise). Someday maybe I will get out of here. Then I will have to begin dissertating, at some other institution. It never ends.

In addition to this I had a bout with the Taiwan A flu. An overwhelming desire to produce tacky souvenirs for sale in airports, an urge to sew cheap clothing for export, and a compulsion to counterfeit Apple computers do not allow for much else. I HATE being sick as I hate letting time slip by--one cannot yet buy more.

School and work have forced me to miss the past four (count 'em) GT events. I am glad to see so many Berserkers (etc.) in such a short time, but I would have liked to attend at least ONE of them....

Recently read GENESIS QUEST and SECOND GENESIS by Donald Moffit. Here are two fine books (with one story). Although Moffit lacks the polish of experience, the books capture the sense-of-life of early Clarke and Niven. Humanity is recreated by aliens 67 million light-years from Earth, and decides to go home. Highly recommended, if you don't mind an occasional clumsiness of prose (the author has only written one other book).

Ishercon Postscript (which through the magic of computing can be put in the middle)> A bomb-defusing contest was the surprise hit of the party, and has led to the proposal of "Tag team bomb defusing" next year. Guy W. provided a bomb with at least six possible defusion(?) methods--the most obvious of which (turning off the digial alarm clock) was not found by anybody. Tullio's bomb took out one team, which then walked around the house like ghosts. The scond team successfully defused the bomb. Barry (whose adventure defusing a real bomb is well-known) defused Guy's bomb, and helped Todd Johnson defuse Tullio's. Barry has achieved the title of advanced amateur, and several comments were heard about how he should do this for a living, get a job with the bomb squad, etc. The TRUE intentions of those who made these suggestions are not quite clear....

On to the MAILING COMMENTS for Apatech 45

RODFORD> Why are some people opposed to SDI? Because they think it won't work--which is (whether true or false) a valid reason. But--these are not the only opponents of SDI. I have cornered some opponents of SDI and asked: WHAT IF it worked? If all technical problems had been worked out--then what do we do? They try and escape through the argument: But they won't and can't be. I reply: That does not answer the question. Assume the problems CAN BE and ARE solved. THEN what do we do? They hem and haw and respond: Don't deploy it. In large part these are the same people who act so pathologically afraid of nuclear weapons that they would do ANYTHING to see them abolished. Why then don't they want a defense (which for the purposes of argument is assumed to work) against those missles? /Anyone who is in favor of any kind of defense must first perceive a threat against which a defence is necessary. What is this threat? Do we need a defence against Canada or Mexico? Are England, France, West Germany, or Japan a threat? One needs defence if and only if a threat exists. What then can we infer about those who do not want a working SDI--will they admit they do not feel threatened by nuclear war? And if they so admit, then why do they claim that nuclear missles are bad? /I shall leave the decision as to whether there is a threat to the conscience of the reader--and I shall leave the consequences of that decision to the reader as well.

BARRY> If Greg Bear had lost the first third to half of EON in a head crash, it would have been a great novel. There is enough about the threat of nuclear war in the newspapers, and it is not necessary to find it in novels as well. Life along the singularity was very interesting, a space battle between Russians and Americans was not. Had the Earth been destroyed in the first chapter and the survivors explored the object and all the alien cultures to be found--had Jim Frenkel thrown out half the manuscript, Bluejay might still be here. >>>>Re yct Donna: Bernard Shaw, after hearing Handel's MESSIAH with (literally) thousands of performers, proposed in Parliament a law making the performance of any Handel oratorio by more than 80 performers a capital offense.

GREG> "The Earth grows enough food for everyone" is not quite precise. The Western democracies alone can feed everyone--if they are allowed to do so. But third world governments do not want to deal with all the peasants left unemployed becaues it is chaper to grow grain in the West and ship it to the poor. Saudi Arabia is presently attempting to become a net exporter of grain--even though its costs are four times higher than India's. India is now a net exporter of grain. India is called self-sufficient in food--but the level of "sufficiency" is lower than that of the poorest American. The poorest fan would be living in relative affluence in India. The only thing these unemployed peasants can turn to is day labor (of which there is little--people come to Bombay to find work, and end yp sleeping on the sidewalks) or cash crops for export: tobacco, coca, marijuana, and poppies come to mind....>>>>Don't get me started on South Africa---I will tell you at great length about real poverty (in India) and about how lucky those black South Africans are to have one meal a day and a shanty to live in. In India it is not uncommon to find familes living under bridges and in cardboard shacks, and often going to bed hungry. It is, I suppose, a tribute to the perseverance of the human spirit that my ancestors hadn't died off centuries ago.

And now for Apatech 46

GUY W> A camping berserker sounds like lots of fun, but Houghton IS twelve hours away...perhaps a staging point could be found.

GUY C> Re YCT Linda: Is it a lack of self-confidence or a lack of motivation which causes bright people to defeat themselves? I have a friend who is very good at mathematics (write down a theorem, and before you finish he'll state two corollaries) but (last time I heard) was living in his car as he simply didn't want to do anything.

ROXANNE> I think that the Mason-Dixon line is on the "fortieth parallel." A few months ago I discussed with some southern fans the idea of holding a DeepSouthCon in Indianapolis, but was told it would have to be on the south (wrong) side of town. The idea died for lack of convention facilities.

GREG> Mathematical Methods courses (as I know them) tend to consist of developing axiomatic structures (such as Hilbert spaces) from first principles. They tend to prove the theorems required to show that the operator math (of the Quantum course the student has already taken) exists. Physics is left to the physicists (most of whom never prove theorems, let alone existence theorems) while mathematicians build structures for which they have no uses. >>>>If you want to have some fun, ask a mathematician about the "Dirac delta function" someday!